

August 1995

Mobile Radio Technology™

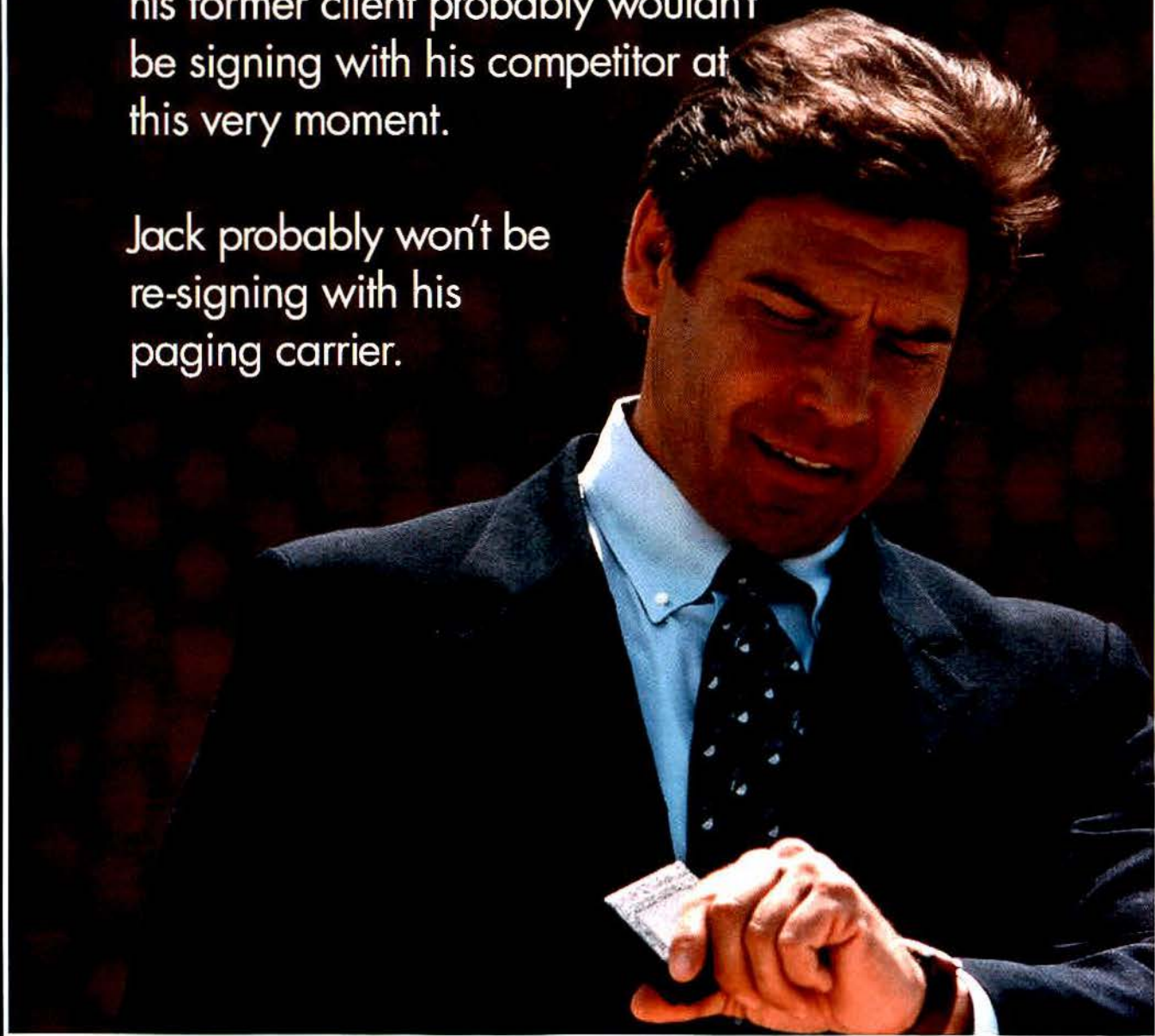
The journal of mobile communications technology

Communications centers, p. 10

- Site management
- Servicing pagers
- Radio equipment removal
- APCO preview

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On the cover: Saddle Peak, Malibu, CA, includes an antenna site with a 150-foot self-supporting tower at 2,836 feet above mean sea level. Photo courtesy of Meridian Communications, Calabasas, CA.

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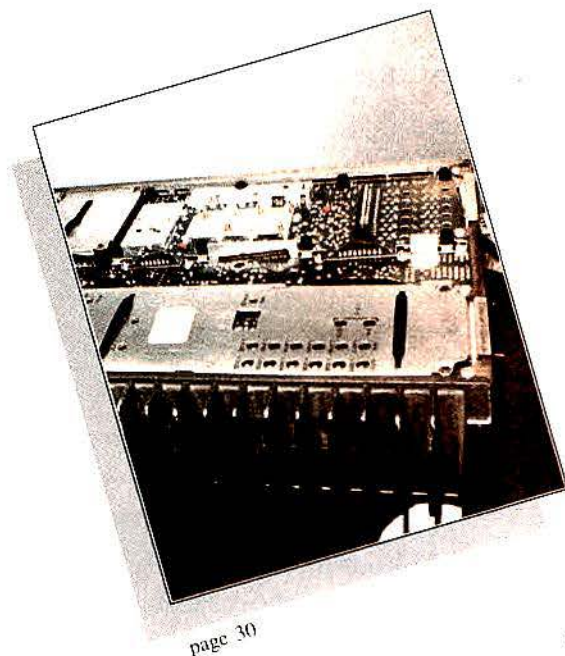
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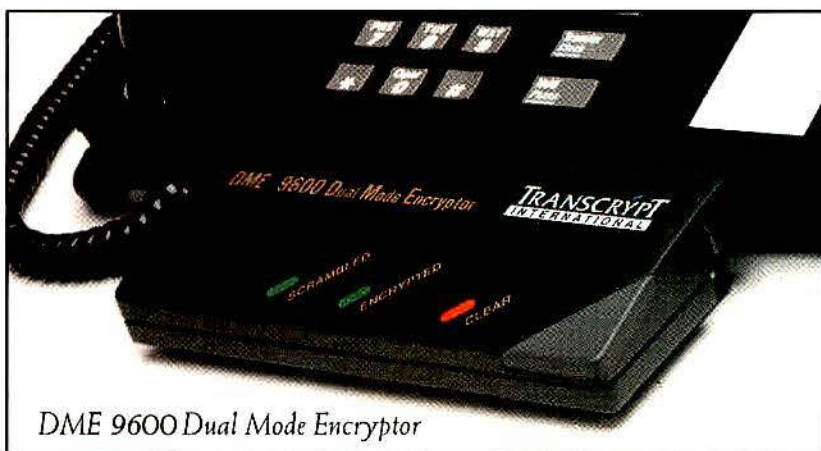


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Spectrum refarming splits channels, lowers power limits—as a start



What did you expect from the FCC about spectrum refarming? Channel-splitting? Power reductions? Trunking? Conversion from FM? User fees? Spectrum auctions? Forced migration to public networks?

Well, channel-splitting and power reductions are a certainty, according to rules that the commission adopted in June. As for the rest, we'll have to wait and see the results of a *Further Notice of Proposed Rulemaking*.

Where channels now are listed every 30kHz in the 150MHz–174MHz band, channels will be listed every 7.5kHz. Where channels now are listed every 25kHz in the 421MHz–430MHz, 450MHz–470MHz and 470MHz–512MHz bands, channels will be listed every 6.25kHz. “Users will have the flexibility of aggregating up to the equivalent of four narrowband channels, provided that spectrum-efficient technology is employed (e.g., 4-TDMA in 25kHz),” an FCC document reads. “This approach will enable users to employ the most spectrally efficient technology available, while causing the least amount of disruption to their own and existing operations. This channeling plan establishes a channelization framework that is flexible and technology-neutral.”

Equipment type acceptance rules will be used to manage the transition to narrower channels. Type acceptance rules govern the sale of manufactured radio equipment. As of Aug. 1, 1996, new type accepted equipment must be designed to operate on channels of 12.5kHz or less, or on 25kHz channels if the narrowband efficiency standard

is met. Multimode equipment that operates on 25kHz channels will be allowed if it is also capable of operating on 12.5kHz or narrower channels.

As of Jan. 1, 2005, equipment capable of operation on 6.25kHz or narrower channels is specified, with similar flexibility to use 25kHz and 12.5kHz multiple-access channels and multimode radios.

Limits based on a combination of effective radiated power (ERP) and antenna height will be imposed and will be based on the size of each station's service area. The stated objectives are to reduce the incidence of over-powered systems, to reduce background noise, to provide technical flexibility and to increase channel reuse. In many cases, though, the limits will require expenditures for additional base stations to maintain adequate radio coverage. The additional cost may drive more private radio users onto public networks, which might be an unstated objective.

The spectrum refarming issues that the FCC did not decide on in June may have

a greater effect than channel splitting and power limits on the ability of private radio users to derive value from their systems.

First, the FCC wants to receive comments on the idea of introducing channel exclusivity where channels now are shared and allowing licensees to lease excess capacity on exclusive channels. Such a plan would turn some private networks into public networks.

Second, the commission asks for comments on the idea of charging fees to all except the public safety users on private radio frequency bands. The fee would be based on the estimated value of the spectrum, calculated on the area and population covered and the amount of spectrum used.

Third, the FCC wants your opinion about creating geographic overlay licenses and using competitive bidding to assign them. Competitive bidding would serve as an alternative to user fees.

Spectrum refarming has barely begun.

—Don Bishop

Radio service consolidation

The FCC has directed the radio communications industry to submit a plan that would consolidate the more than 20 private land mobile radio services into as few as two to four. One service would include all public safety users. “Consolidation of the service groups will provide for more efficient allocation of the increased capacity created by the introduction of more efficient technology,” an FCC statement on the subject reads.

A “radio service” exists as a body of FCC rules that identify who is eligible for radio licenses. The rules specify for what purpose the radio equipment may be used, the equipment's operating limits, and, perhaps most important, the frequencies that can be licensed.

Take the Police Radio Service, for example: “Any territory, possession, state, county, city, town, and similar government entity, including a governmental institution authorized by law to provide its own police protection, is eligible to hold authorizations in the Police Radio Service to operate radio stations for transmission of

communications essential to official police activities of the licensee.” (FCC regulations.)

Consolidation of radio services may cause some trade associations to go out of business and others to merge. Having fewer trade associations may strengthen the industry's voice in Washington, where the now-fragmented land mobile radio industry competes with others for radio spectrum. It may lead to competition among frequency coordinators, at least partly satisfying those who object to the current monopoly certification of certain trade associations to coordinate frequencies for their associated radio services.

With certain exceptions, license applicants must submit their paperwork and a fee to a specific coordinator that does preliminary work for the FCC in confirming the applicant's chosen frequency or an alternative. Competition might reduce the fee; presently, applicants have no choice but to pay the coordinator's price.

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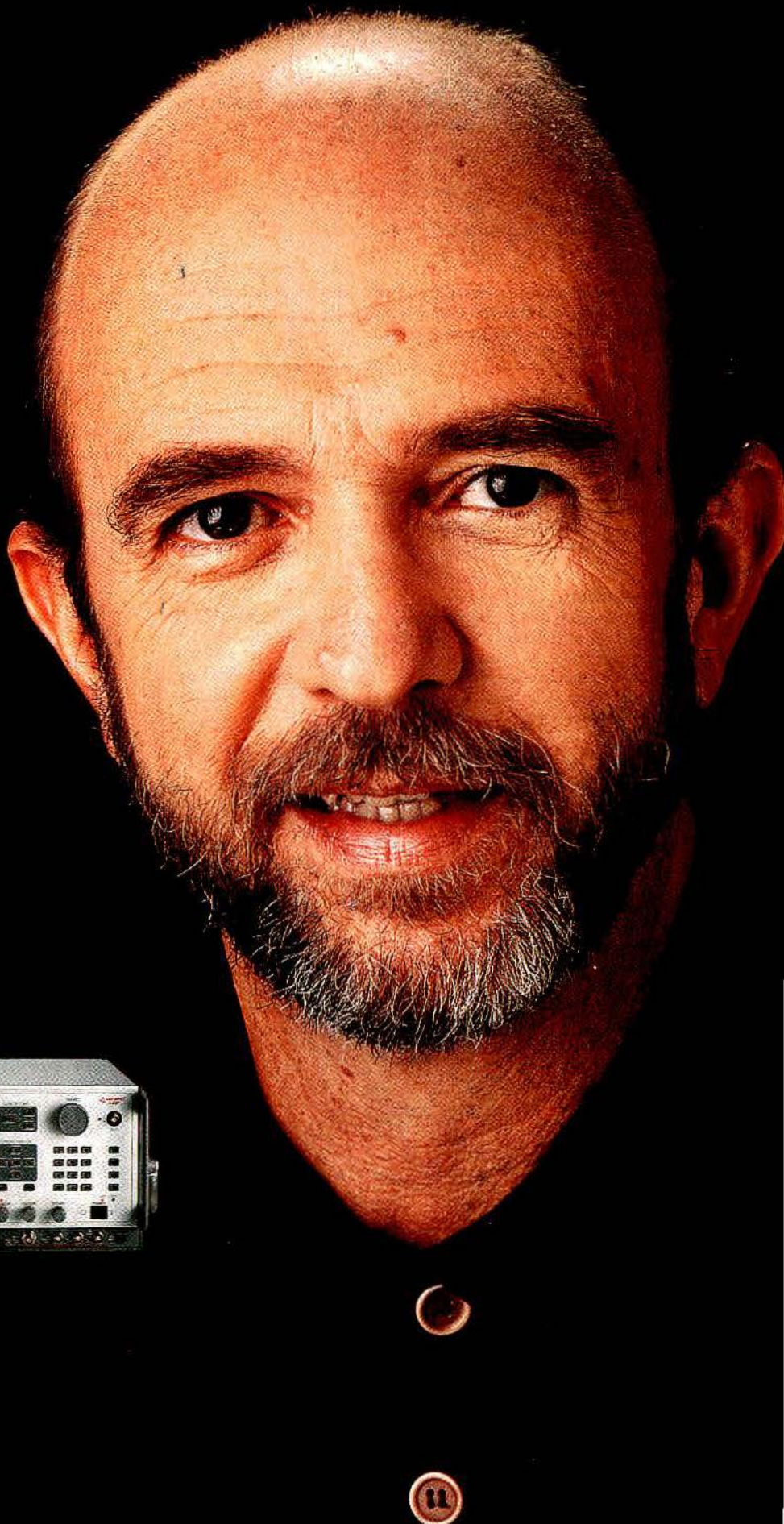
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13-17—Association of Public-Safety Communications Officials—International National Conference, Detroit. Contact: 800-949-2726.

September

21-23—Personal Communications Showcase, sponsored by the Personal Communications Industry Association (PCIA). Orange County Convention Center, Orlando, FL. Contact: 800-326-8638.

October

16-18—International Conference on Power Requirements for Mobile Computing and Wireless Communications, sponsored by BIS Strategic Decisions, Santa Clara Westin & Convention Center, Santa Clara, CA. Contact: 617-982-9500.

18-20—International Wireless Communications Expo/Fall has been canceled.

19-20—AMTEX, the American Mobile Telecommunications Association's Marketing and Technology Conference and Exposition, Hilton, Walt Disney World, Orlando, FL. Contact: 202-331-7773.

26—ERA Communications Trade Fair, Ala Moana Hotel, Honolulu. Contact: 310-287-1218.

29-Nov. 1—Wireless Apps, sponsored by the Cellular Telecommunications Industry Association, The Mirage Hotel, Las Vegas. Contact: 202-785-0081.

November

7-9—WirelessWorld Conference and Exposition, sponsored by Cellular Business and Mobile Radio Technology magazines, Moscone Convention Center, San Francisco. Contact: Chris Lotesto, 800-458-0479.

8-12—Communications Marketing Conference, sponsored by the Communications Marketing Association, Albuquerque, NM. Contact: Bernie Brownson, 303-371-8182.

17—Radio Club of America, Communications Symposium, 86th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Ron Formella, 201-652-6811.

1996

January

17-19—Mobile Communications Conference, sponsored by Frost & Sullivan, Westin Galleria Hotel, Dallas. Contact: Amy Arnell, 415-961-9000.

March

17-20—Energy Telecommunications and Electrical Association, Dallas Convention Center, Dallas. Contact: 214-235-0655.

23-25—Wireless '96, sponsored by the Cellular Telecommunications Industry Association, Dallas. Contact: 202-785-0081.

April

24-26—International Wireless Communications Expo/Spring, Las Vegas Convention Center, Las Vegas. Contact: 800-828-0420.

May

29-31—Radiocomm, Metro Toronto Convention Center, Toronto. Contact: 613-233-4888.

June

24-27—Supercomm, sponsored by USTA and TIA, Dallas Convention Center, Dallas. Contact: 202-326-7300.

July

11-13—Communications Expo/Show of the Americas, Miami, FL. Contact: 305-229-9992.



Mobile Radio Technology

The Journal of mobile communications technology

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Analyzing two-port devices using S-parameters

By Harold Kinley, C.E.T.

Using *scattering* parameters, or S-parameters, any two-port device can be analyzed and treated as a black box with an input port (1) and an output port (2). By studying the S-parameters, much can be learned about the behavior and operation of the two-port device. The device can be an active or passive component, or both. The measurements consist of both *magnitude* and *phase angle*. No matter how simple or complex a two-port device may be, it can be analyzed using S-parameters.

S₁₁ Forward reflected

Figure 1 below explains the S-parameters that we will explore. In Figure 1A, the parameter S₁₁ consists of the *forward* voltage wave and the *reflected* voltage wave. Remember, S-parameters have *magnitude* and *phase*. If we are to compare the reflected voltage with the forward voltage, we must also consider the phase angle.

In Figure 1A, the parameter S₁₁ is a measure of the impedance match or mismatch at the input port. The incident signal voltage is applied to the input port (1) and the reflected signal voltage is mea-

sured at the input port (1); thus, the expression, S₁₁. All S-parameters can be expressed either as a numerical factor or in decibels.

At the input port (1) in Figure 1A, the reflected voltage divided by the forward voltage is S₁₁. This quotient is equal to the reflection coefficient, Γ , from 0 to 1. This coefficient also can be expressed in decibels as $20\log\Gamma$. This quantity is equal to the *return loss* at port 1. So, S₁₁ is equal to the reflection coefficient or the return loss at port 1, depending on how it is expressed.

S₁₂ Reverse transfer

The S₁₂-parameter is illustrated in Figure 1B. This coefficient is a measure of the amount of signal transfer from port 2 to port 1. Typically, port 1 is considered to be the input port, and port 2 is considered to be the output port. Some circuits are bidirectional; that is, it makes no difference which port is the input or the output. The signal transferred between the two ports is equal in either direction.

However, in the case of an amplifier, with port 1 the input and port 2 the output, the signal transfer from port 1 to port 2 would be different from the signal transfer from port 2 to port 1. The signal transfer from port 2 to port 1 would be a measure of the amplifier's isolation. Again, the amount of signal transfer can be expressed in decibels or as a multiplication factor.

S₂₁ Forward transfer

S₂₁ is a measure of the transfer of signal from port 1 to port 2. (See Figure 1C.) If this circuit is an amplifier, the S₂₁ parameter would be a measure of its forward gain. This gain can be expressed as a multiplication factor or in decibels.

S₂₂ Reverse reflected

The S₂₂ parameter is a measure of the reflected signal at the output port with the incident signal applied at the output port. (See Figure 1D.) It can be considered to be a measure of the impedance match or mismatch in the reverse direction. As in the case of the input port (S₁₁), when expressed as a factor from 0 to 1, this factor is equal to the reflection coefficient, Γ . When expressed in decibels, $20\log\Gamma$, this value is equal to the return loss.

Examples

Probably the best way to understand S-parameters is to examine a few examples. Any two-port device, no matter how simple or complex, can be analyzed with

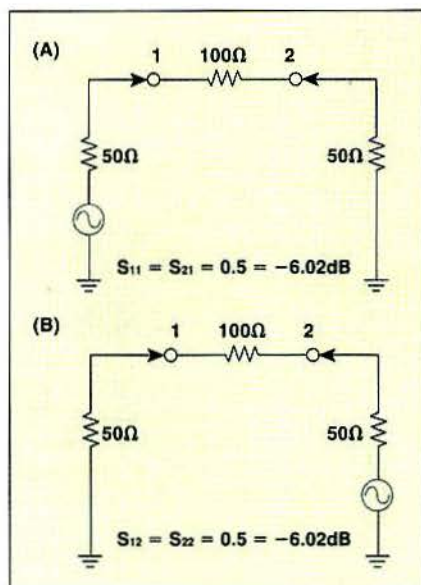


Figure 2. Figure 2A shows a 100Ω two-port device being tested for the S₁₁ and S₂₁ parameters. Notice the connection of the termination and the generator. Figure 2B shows testing for the S₁₂ and S₂₂ parameters. Notice that the generator and termination are reversed from Figure 2A.

S-parameters. In Figure 2 above, a simple resistor is a two-port device. It can be analyzed with S-parameters just as any other two-port device.

When analyzing two-port devices with S-parameters, be sure to terminate the *measure* port with an impedance equal to the system impedance. Also, the source impedance (generator) must equal the system impedance. The discussion in this column assumes a system impedance of 50Ω.

Referring to Figure 2, to measure the *forward-reflected* S₁₁-parameter, the signal is applied to port 1 and measured at port 1. To measure the *forward-transfer* S₂₁-parameter, the signal is applied to port 1 and measured at port 2. (See Figure 2A.) The 100Ω resistor in series with the 50Ω load yields a 150Ω impedance as seen at the generator output at port 1. The VSWR is then 3:1 (150/50). S₁₁, the reflection coefficient, Γ , is then equal to $(S-1)/(S+1)$, or 0.5.

(continued on page 68)

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, Prentice-Hall, 1985. He is a member of the Radio Club of America.

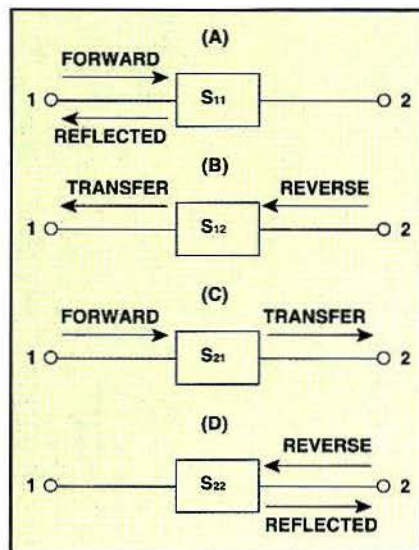


Figure 1. Figure 1A illustrates the *forward-reflected* S₁₁-parameter. This is equivalent to the reflection coefficient or return loss at the input port (1). Figure 1B shows the *reverse-transfer* S₁₂-parameter. It is the equivalent of isolation. Figure 1C shows the *forward-transfer* S₂₁-parameter. It is equivalent to gain. Figure 1D shows the *reverse-reflected* S₂₂-parameter. It is the reflection coefficient or return loss at the output port (2).

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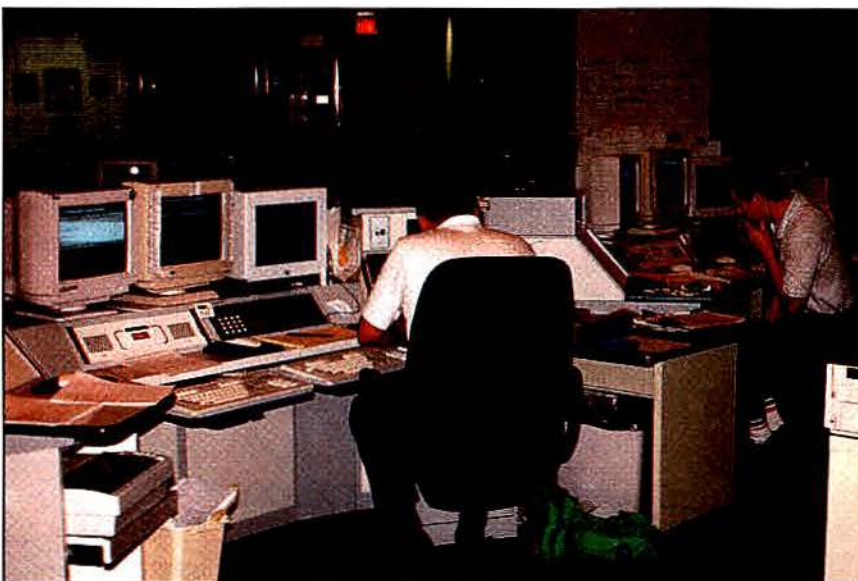
By David A. Binns

In Eau Claire, WI, the City-County Emergency Communications Center provides dispatch services to 14 public safety agencies including E9-1-1, law enforcement, fire protection and emergency medical communications. To meet growing needs for communications services, the center has completed a full equipment upgrade, replacing mechanically switched consoles that were installed in 1977. The new installation meets increased response requirements and provides emergency communications services required by additional county agencies.

The new communications control system uses independent microcontrollers, making individual workstations capable of independent operation. With either mouse or trackball peripherals, the control system uses two software programs, one for screen design and one to define operating limits.

Communications center employees designed distinctive screens that are unique to the center's operations. Dispatching in a countywide environment for 14 agencies demands a number of custom applications. These applications were developed by the center's staff with guidance from my employer.

Larry J. Agema, the center's director, said that when the console furniture and electronics were delivered, the screens already had been planned and created on the center's personal computers (PCs). The results were easily transferred to the new



The Eau Claire, WI, City-County Emergency Communications Center workstations are capable of independent operation, thanks to individual microcontrollers. Center employees designed the CRT screen layouts themselves.

Binns is vice president, marketing, at Modular Communication Systems (Moducom), North Hollywood, CA. Moducom makes the Ultra-Com Pro microprocessor-based communications control system and the Screenmaker screen design and Customizer operating software described in this article.

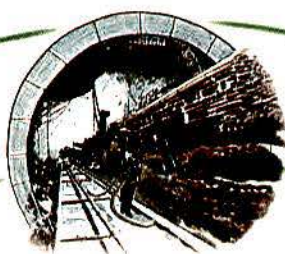


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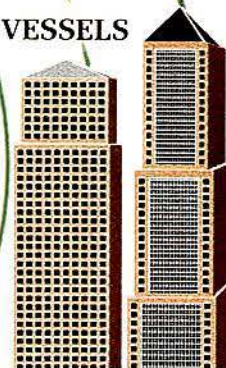
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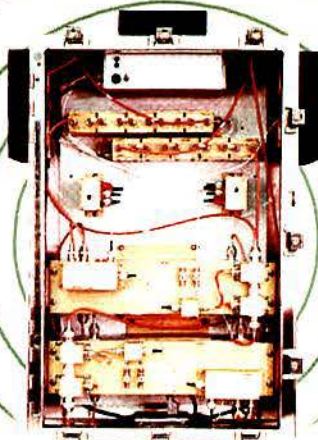
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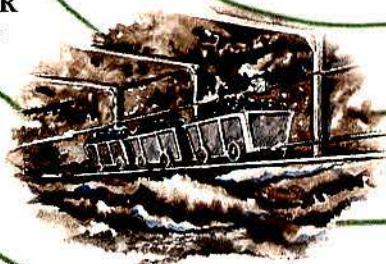
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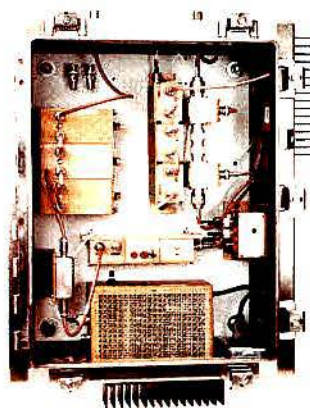
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800 MHz two-way repeater amplifier
(With output level control and high selectivity
8-section combline filters)



MINES



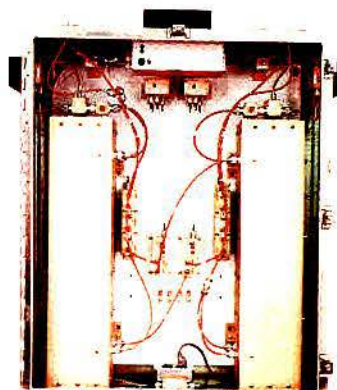
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equipment. Any necessary changes were simple to make with the screen design and operating programs in the new software.

The communications control system allows the user to change and modify software to accommodate Eau Claire's operational requirements. The software, which uses off-the-shelf database technology, is more "user-friendly" compared with other video-based systems that were considered. "The center's selection criteria," Agema

said, "included cost-effective equipment and the capacity to serve a growing community in the face of shrinking budgets. Equally important was the acceptance of the new system by dispatch center personnel."

The control system is based on 80486 microcomputer chip PC technology, supported by Intel's 16-bit 8097 microcontroller.

"Because the user can configure the

software," Agema said, "less assistance is required from the supplier to improve efficiency in the operating environment for dispatchers and technicians."

A number of vendors were sent a request-for-proposal (RFP) that included the possibility of a video-based system. Although a mix of push-button and cathode-ray tube (CRT) was considered, the center decided to use full CRT technology.

The purchase decision was based on a unique point-based system. Bids were sought from prospective vendors that could supply CRT-controllable dispatch consoles. Points then were assigned to various parts of the proposals, and the point totals were divided into the purchase price. This process ensured that the high-dollar bidder had the same chance at success as the low bidder.

"The new dispatch workstations overcome limitations that the mechanical switching consoles could not," Agema added. "The system is expandable almost instantaneously on installation of the new radio channels. Newly installed channels can be created by a staff member using the screen-design software—a technician's services are not required."

Another important consideration was the use of "hot standbys" for the power supplies and main processors. This feature provides a level of redundant operation that is monitored and reported in print by the console controller. The old equipment could not diagnose its own malfunctions, so a technician had to investigate every failure. If the performance of the new dispatch consoles deviates from the norm, a printer produces a hard-copy report, an alarm sounds at the dispatcher console and a visible message explains to the dispatcher what has taken place.

Training was started by familiarizing workers with the screens, working off-line to see the results of their efforts and to fine-tune the screens in response to their comments. Additional training was provided for the technical staff to facilitate on-going maintenance. Agema said that the employees' success in learning the system can be attributed largely to the software's "user-friendliness."

In the past, the communications center could only guess at the level of activity on the communications systems. The computer-controlled dispatch system provides accurate transmission-and-receive reports from all active channels. This information is invaluable when it is necessary to document the need for additional staff.

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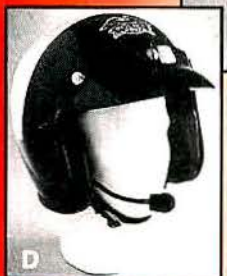
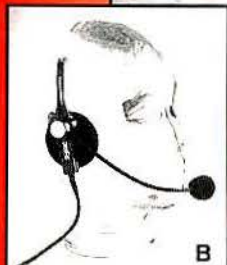
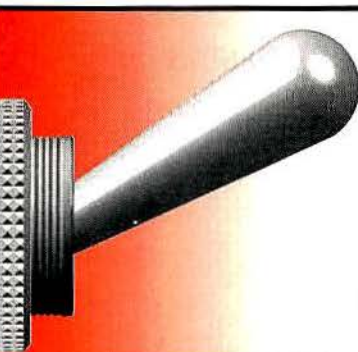
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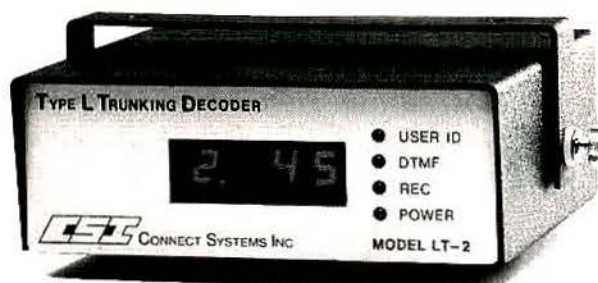
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Managing antenna sites

The common denominator for obtaining the desired and required service starts with—and heavily depends on—having a site manager who wants to provide the best service and facilities.

By Richard J. Reichler

For radio communications equipment to perform properly, the antenna sites must be effectively managed. A radio system operator first becomes involved with site management when planning the system

and its installation, and later when complying with installation standards and continuing with maintenance.

Whether supplied by the site manager's staff or by subcontractors, successful management requires expertise in various specialties, including RF propagation, intermodulation interference, RF hard-

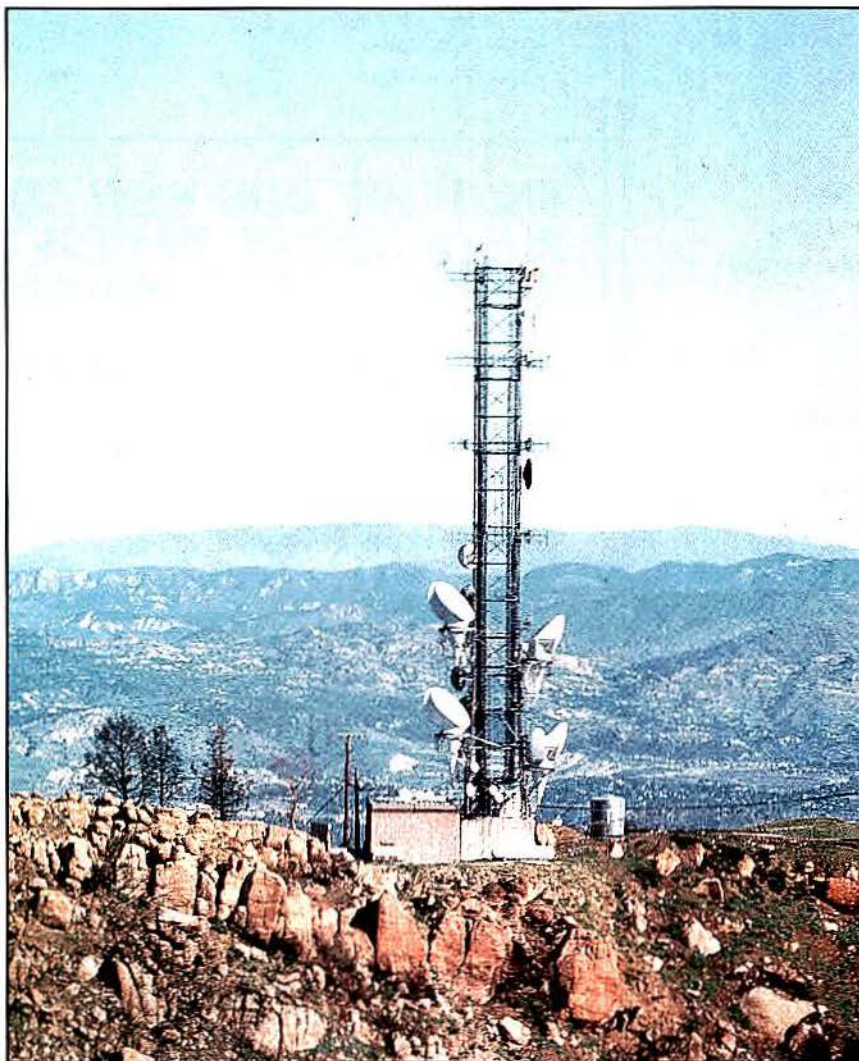
ware, environmental regulations, zoning, tower maintenance, air conditioning, commercial power, standby power, grounding and security systems. Gone is the time when new occupants at sites were told "Just find a place on the tower and in the building."

Site managers now maintain detailed plot plans and charts showing the exact location and technical data of every piece of equipment in the buildings and on the towers. The technical data include frequencies, output power levels, effective radiated power (ERP) and other useful information. Site management employees work hard to select specific locations in the building and on the tower to maximize performance and minimize interference. Computerized intermodulation studies are used to look for and to eliminate potential interference problems. Most knowledgeable site users insist on this increased level of management.

Installation standards, enforcement

Strict standards for installation must be set and enforced by the site manager to keep a site working well for all users. These standards normally require equipment identification labels and special hardware.

Identification labels are essential at shared facilities. Labeling extends beyond FCC requirements, especially regarding antennas and cables. Many managers require each transmission line to be marked. This marking helps technicians to locate the correct line to be observed and worked on. One technique is to apply colored tape at various points using a three-color combination unique to each cable. Posting an emergency contact name and telephone number on your radio equipment can be helpful if a visiting technician should detect a problem with it.



Saddle Peak, Malibu, CA, includes an antenna site with a 150-foot self-supporting tower at 2,836 feet above mean sea level.

Reichler is vice president of Meridian Communications, Calabasas, CA, a telecommunications site management company. He is a member of the Radio Club of America.

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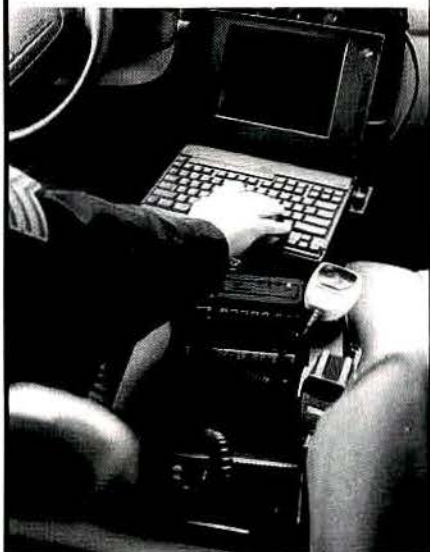
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BY RITRON

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Hardware standards help to minimize interference. Interference-alleviating devices such as cavity filters and isolators normally are required, and standards may include minimum isolation levels. Expect to use double-shielded cable and to tie the radio system into the facilities' grounding system at appropriate points. Usually, stainless-steel or hot-dip galvanized mounting hardware is required.

Other hardware standards may involve system component reliability, environmental control and safety. Additional requirements help to minimize tower wind loading and to reduce damage to the buildings, towers and other structures.

In addition to periodic routine site inspections, a site management employee must visit during or soon after each installation and removal to inspect the work and to enforce the standards. Some site users may complain about the expense and inconvenience that strict standards may cause; nevertheless, all users sharing a site facility will be grateful and appreciative in the long run for strong standards and enforcement.

Priority management activity

Good management means more than inspecting radio hardware installations and removals. The manager should keep up with state-of-the-art techniques and equipment to improve the facilities. Site management includes maintenance efforts to reduce interference and to maintain security, environmental control, power circuits, towers and equipment rooms.

To reduce potential intermodulation interference, towers are inspected and maintained by removing abandoned antennas and cables, eliminating rust and correcting other situations that could cause intermodulation interference. Equipment is monitored and inspected for degradation that could harm other users' communications, not to mention the equipment's specific user.

Keeping facilities secure involves various procedures, including using strong doors, locks, fencing and alarm systems. Site managers periodically change locks and combinations. They are careful when granting access to a facility and in responding to changes in users' employee rosters. Security systems that can be programmed by remote control are available to restrict entry into individual rooms. The door locks respond to individual keys. The system records who accesses each door by date and time.

Sensitive equipment needs a proper environment. Site management employees periodically maintain the air conditioning to keep the temperature and humidity in

the right range and to reduce dust. The manager periodically reviews the air conditioning capacity in view of changing circumstances. Also, site employees inspect and correct other room equipment such as the cable port hole entries and door seals to be sure they are kept weatherproof.

Site management employees see to it that power distribution systems and standby power generators are well-maintained. Managers make sure that generators are periodically exercised and fueled. Generators are run and tested under full load; their capacity is increased when needed.

Towers are inspected and maintained regularly to keep the bases, tower material, guy wires, bolts, paint, lighting, grounding, climbing ladders and cable routing hardware in proper condition. Also, the status of the mounting of the antennas and cables is checked; site users might be expected to make any needed repairs. The tower wind loading is studied, and then modifications are made as needed.

In addition to maintaining security, environmental and power system components in the equipment rooms, managers paint, dust and clean them regularly. They maintain fire suppression systems and replace light bulbs.

Remote site monitoring and control

Systems for remote site monitoring and control keep improving and are becoming more cost-effective. Many systems have been available for monitoring tower lighting. It now may be economically practical for the site manager to remotely monitor room temperature, the power source and fossil fuel levels, as well. Such extensive monitoring may augment or replace existing security systems. Site managers can be alerted immediately to an alarm condition or can query the systems to check the current status of a function. The site manager also might use these systems to control facility equipment such as air conditioners and generators.

Future needs

When site needs change or increase, the site manager can assist. Many managers can help to modify or to expand an existing facility, or to develop a new one. These efforts require a knowledge of government regulations, lease negotiation and facility design and construction.

The common denominator for obtaining the desired and required service starts with—and heavily depends on—having a site manager who wants to provide the best service and facilities.



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- Each memory location can have different CTCSS and/or DCS for encode or decode
- Emergency ANI with repeat delay timer
- Accidental "man down" warning tone timer
- Field-selectable positive and negative squelch output
- CTCSS modulation is programmable relative to ANI
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- Encodes Burst tone with programmable frequency & timing
- Emergency ANI with repeat delay timer
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- Field-selectable positive and negative squelch output
- CTCSS can be held off before and during ANI
- CTCSS modulation is programmable relative to ANI


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They moved the main building's repeater up-ward seven floors, and switched from cable to antenna...installed isolators on selected transmitters...integrated specialized coaxial relays into the paging system...and consolidated widely dispersed rf equipment at a single site.

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Servicing pagers: 450MHz receiver boards

Part 17—Here are some details about the inner workings of UHF Bravo Plus and Bravo Express receiver circuitry. Use an 'unknown' feature during extensive troubleshooting of the circuit boards.

By David Ludvigson

The lady came up to me quietly with a furtive look. "Can you fix this?" she whispered.

I looked at the pager in her hand. It was a Bravo Plus, or at least the circuit boards that make up the Bravo Plus. Neatly sandwiched between the front lens and the light diffuser were the remains of the liquid crystal display (LCD), its flex-strip curl-

ing lazily at the bottom of the case.

Rule 1. When disassembling a Bravo Plus to make any repairs, remove the diffuser lens by placing a jeweler's screwdriver between the screw retaining post and the edge of the diffuser lens, and gently "rock" the screwdriver to release the friction-fit part. Forcing the circuit boards out of the case without performing this step results in much unneeded cost and frustration!

Logic and receiver board removal then may be accomplished by the same technique used for the Bravo pagers. (See Figures 1 and 2 below.)

The NRE series of Motorola Bravo Plus

and Bravo Express receiver boards for 406MHz-512MHz includes:

NRE6550B	45MHz IF	406MHz-423MHz
NRE6551B	45MHz IF	435MHz-450MHz
NRE6552B	45MHz IF	450MHz-465MHz
NRE6553B	45MHz IF	465MHz-480MHz
NRE6552A	45MHz IF	450MHz-465MHz
NRE6553A	45MHz IF	465MHz-480MHz

Figure 3 on page 22 illustrates the parts and functions of the receiver boards. See the appropriate Motorola technical manual for a complete schematic.

Q451 and Q452 are configured as a cascode amplifier, capacitively coupled to

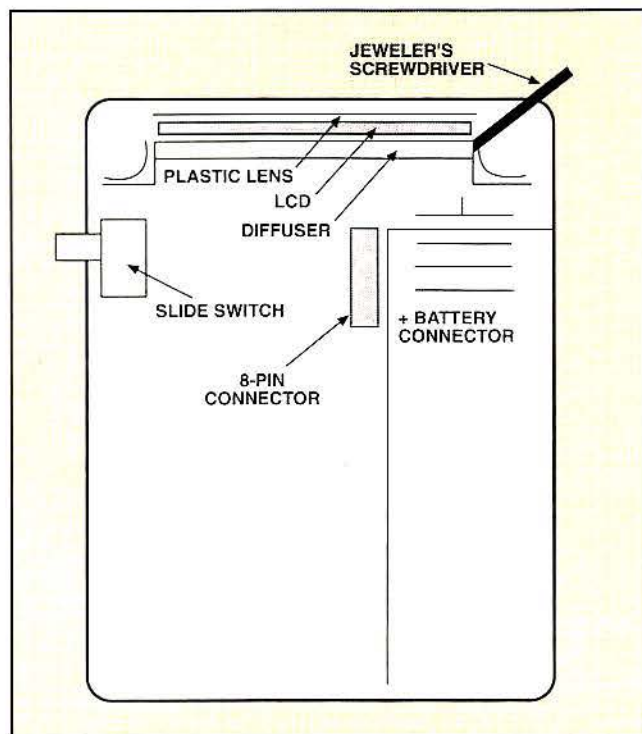


Figure 1. Step 1: Turn the pager off. Remove the battery clip at the bottom of the case, and remove the battery. Insert a jeweler's screwdriver at the edge of the diffuser lens to remove it.

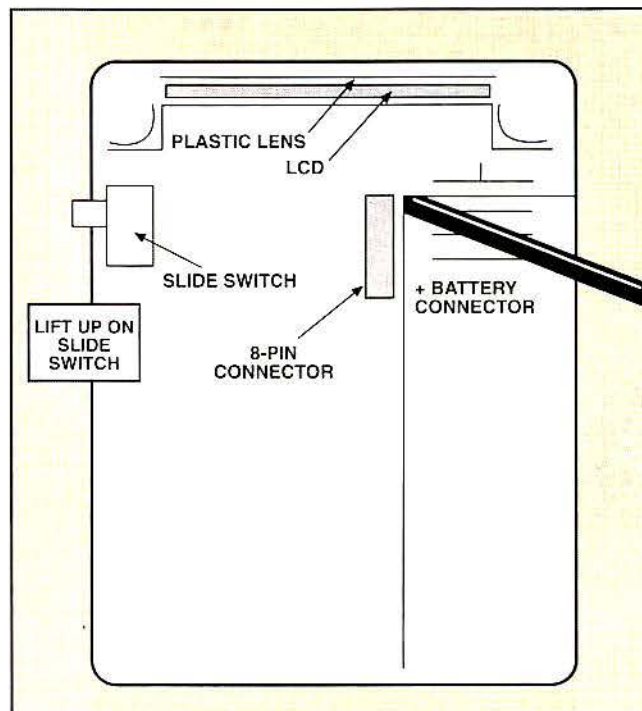
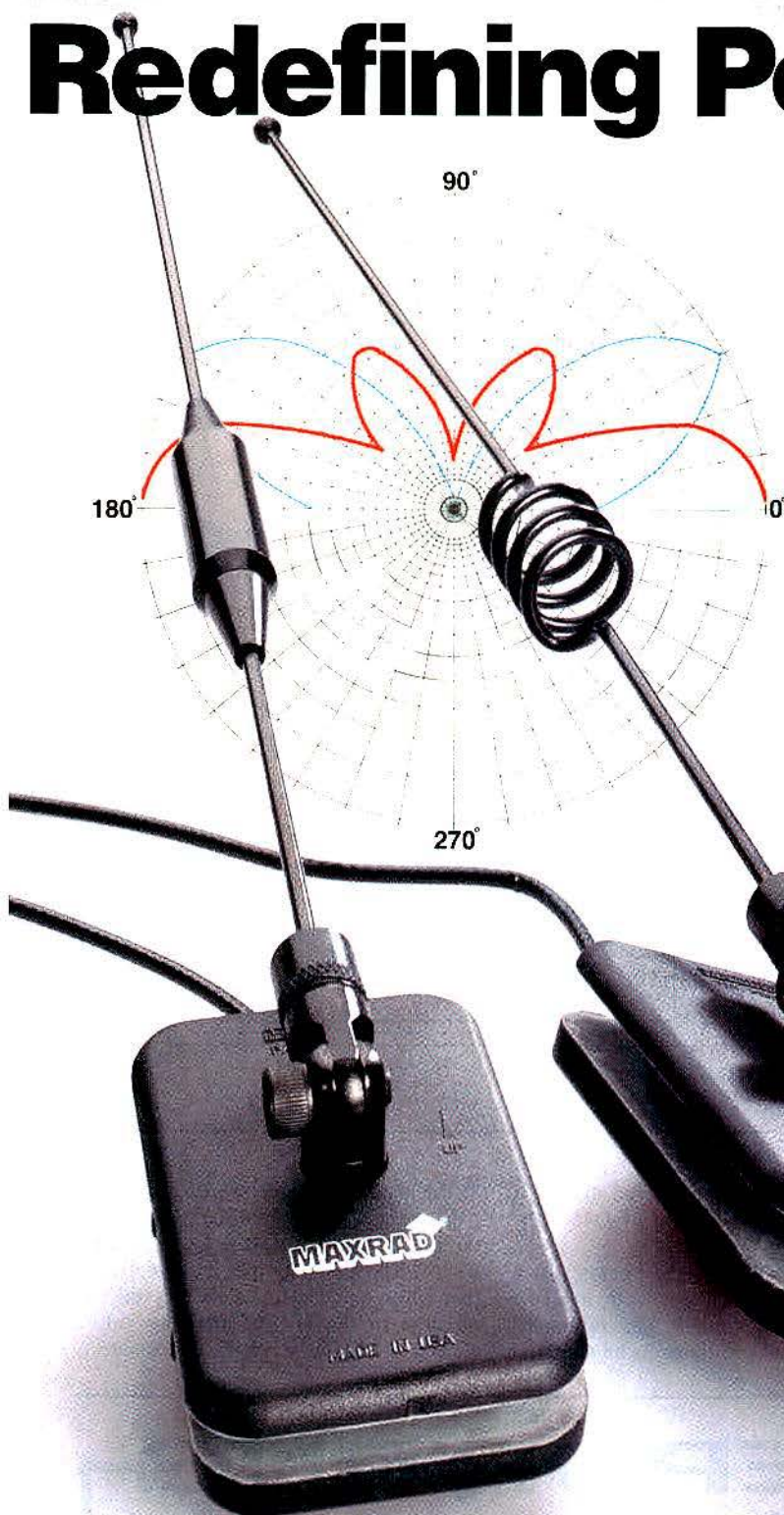


Figure 2. Step 2: With a small screwdriver placed at the "L" formed by the circuit board (to the left of the positive battery spring) and while lifting the lever of the side-mounted on-vibrate-beep switch, gently wedge the entire unit from the case.

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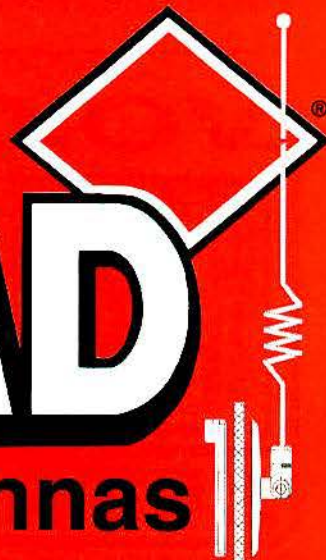
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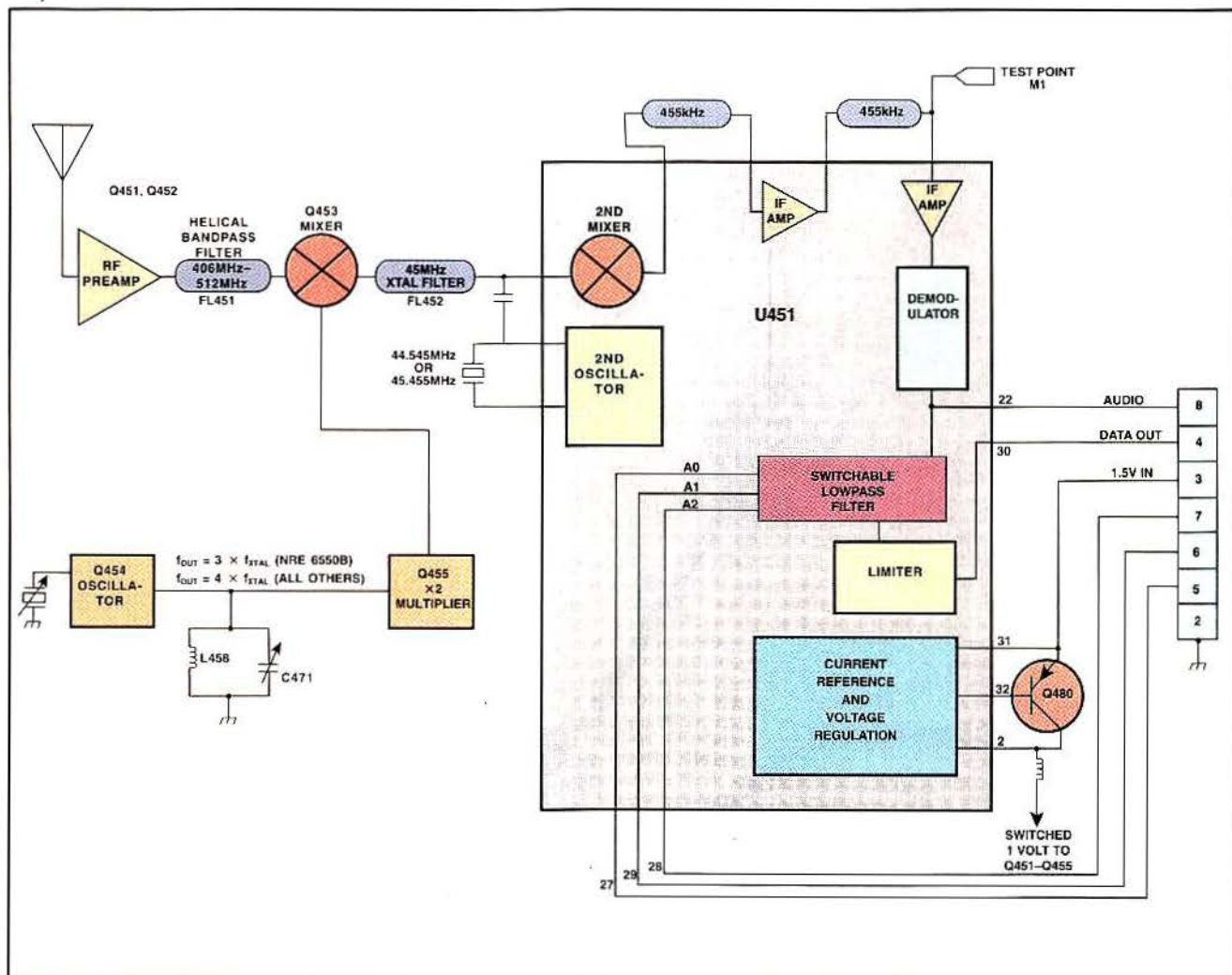


Figure 3. 406MHz-512MHz receiver boards. See text for multiplier operation details.

the loop antenna. Diode CR451 prevents damage by clamping any excessive signal levels to ground. The resulting amplified 406MHz-512MHz signal is injected through FL451, a helical filter generally broad enough to pass a 15MHz range without significant band-edge attenuation.

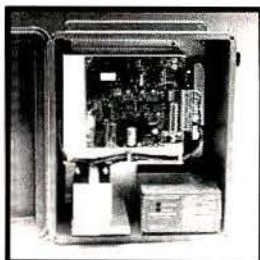
The preamplified and filtered signal is then presented to the base of Q453, the first mixer.

At the same time, Q454 operates as a Colpitts crystal oscillator with a bit of L455 slug-tuning applied. This tuning allows the crystal oscillator to be centered

at the required frequency to decode the paging signal properly. (See "Tales Crystal Filters Tell ..." in the October 1994 issue.) The Q454 output is actually either three or four times the crystal frequency. In the NRE6550B, the values chosen for Q454's collector resonate at

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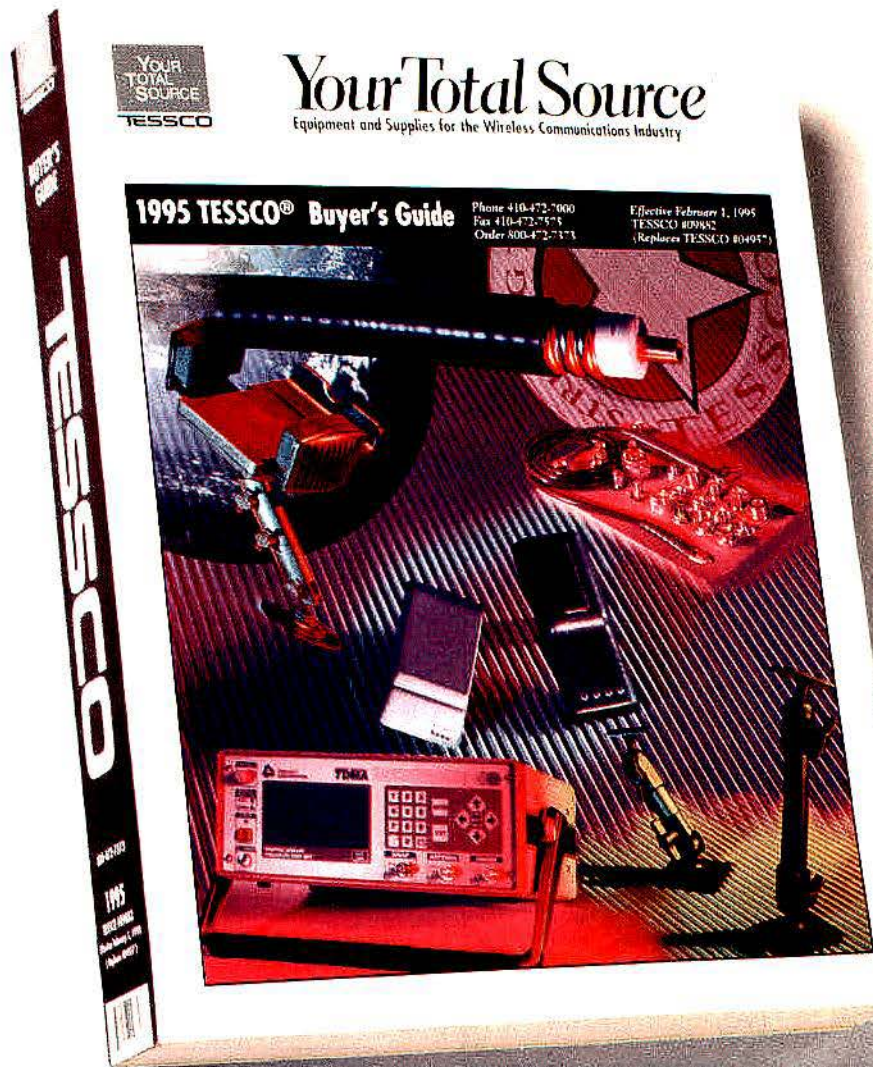
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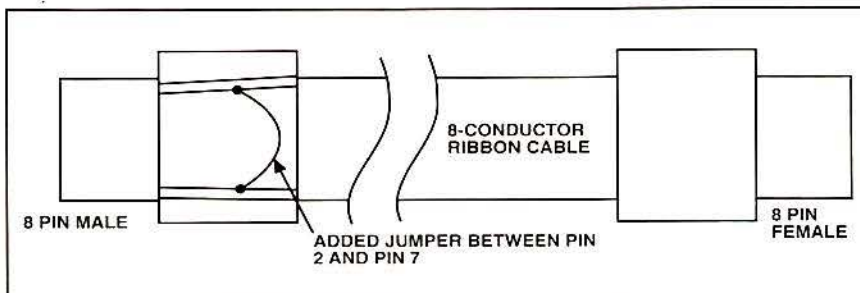


Figure 4. Modification to extender cable for Bravo Plus and Express pagers (*not* for Bravo). See text for details.

roughly three times the crystal frequency. All other NRE-series receivers are tuned to four times the crystal frequency.

Capacitively coupled, this three-or-four times crystal-frequency signal is applied to another filter (L458 and C471) that removes virtually all other frequencies besides the multiplied signal output. Q455 operates as a frequency doubler, yielding an overall output frequency of either six or eight times the crystal frequency. This signal is also applied to the base of mixer Q453.

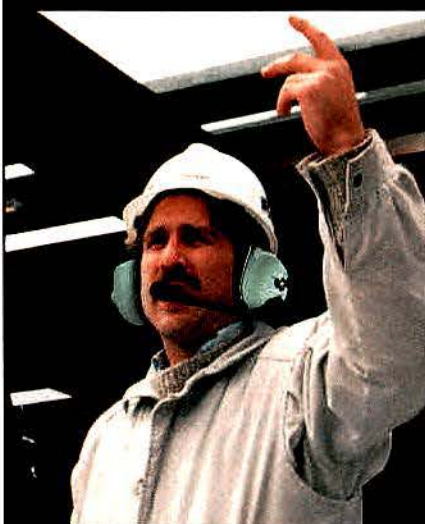
Q453 (in the case of a NRE6552B) receives an oscillator frequency of eight times 50.6363MHz (405.09MHz) and an incoming range of frequencies that is determined by the bandwidth of the 450MHz–465MHz helical filter. Limited to a crystal frequency of 45.0MHz for the center of its response, signals around $405.09\text{MHz} + 45.000\text{MHz} = 450.09\text{MHz}$ are passed for further processing and decoding.

The crystal used for the second oscillator *should* be color coded brown for 45.455MHz and violet for 44.545MHz. The 45.455MHz version probably will require *data inversion*. (Respond YES to the programmer when the CUSTOMER REQUIRES DATA INVERSION prompt appears.) The 44.545MHz version probably will *not* require data inversion. *In either case, tune the crystal frequency for the first strong peak on the IFFER as the slug is tuned clockwise into the core.* (Again, see "Tales Crystal Filters Tell ..." in the October 1994 issue.)

Capacitive coupling is used to feed the second oscillator output into the second mixer within "jungle chip" U451, so called because of its complexity. At this point, the signal passing through FL452 is mixed with the second oscillator output to produce an output of 455kHz. This 455kHz signal is amplified through a pair of intermediate frequency (IF) amplifiers, and then demodulated by a quadrature detector. Audio output is brought out through the chip's pin 22 and also presented to the switchable lowpass filter. Line A2 (pin 28) is enabled by the battery-save strobe. Lines A0 and A1 (pins 27 and 29, respectively) control the bandpass characteristics of the signal that reaches the limiter. The signal is subsequently processed as output data.

There is an undocumented (and virtually unknown) feature of the Plus and the Express that may help you if you conduct

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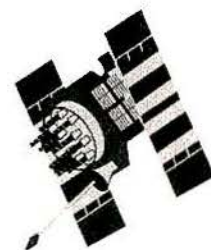
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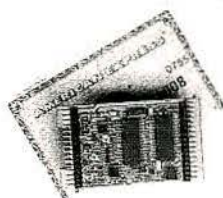
Everyone, it seems, is talking about the Global Positioning System, or GPS. GPS is a recent innovation in precise low-cost satellite-based positioning technology. And, when installed in a two-way equipped vehicle, GPS-based Automatic Vehicle Location (AVL) systems are capable of streamlining fleet operations by showing dispatchers the accurate location of every vehicle in the fleet. Now Cimarron brings GPS/AVL technology to radio-based fleet vehicles, simply and without the "Big System" costs.

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extensive troubleshooting on either circuit board. On the jumper-cable used to interconnect these boards, place a jumper between pins 2 (ground) and 7 (A2) as shown in Figure 4 on page 24. This jumper allows the receiver to operate "full-time" while the microprocessor continues to perform all of its "house-keeping" and "decoding" chores. An on-frequency POCSAG signal with a matching capcode and baud-rate will

cause a "full-response" (alarm active for length of time determined when programmed). When troubleshooting, this utility should be of considerable value.

To this point ...

Many telephone calls have been received regarding some of the pagers that have been troublesome. One complaint is that there is a strong signal at test point M1 but no subsequent decoding. Test

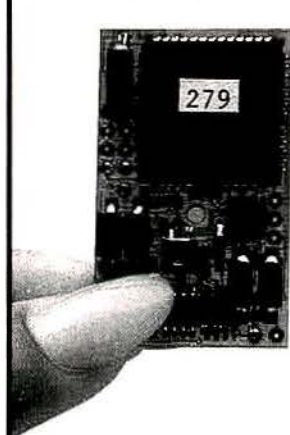
point M1 is far removed from the actual demodulating stage (as shown in Figure 2). It is certainly possible to have a perfectly working "receiver" at 455kHz but nothing coming from the demodulator or audio stages. I use a dual-trace scope to look at what is available for both audio and data (pins 8 and 4 on the Plus and Express receiver boards' interconnect block). That "jungle-chip" does not stop at the IF! Keep a few test receiver and decoder boards around and try replacing suspected faulty boards with known good boards. If the signal at M1 looks good but decoding does not take place until the receiver board is replaced, then the demodulator or signal-processing section of the jungle-chip is falling down. Often, this failure may be traced to a loose chip capacitor or resistor.

Another problem is locating the operations frequency of some pager with its crystal-frequency marking positioned away from a viewing plane. The Ramsey Com 3 service monitor provides a programmable offset frequency, which I have set to 0.0250MHz for all pager frequencies. Merely putting the Ramsey into *generate* mode with a 1kHz tone allows me to sequentially move the frequency up or down in 0.0250MHz steps. This single feature of the Com 3 has saved countless hours of removing crystals and performing the math to calculate the operating frequency! On the Com 3, press *CLR*, enter .0250, press *STO* and *OFFSET* +. The same offset is useful on 450MHz. A tip of my hat to Ramsey!

There also has been mention of the "single-board Motorola pagers." These pagers basically are early versions of the two-board Bravo units and *may or may not* be worth the time to explain. To program them, select "BAB" on the programmer. To get them to work properly usually requires setting them for data inversion (DI=Y). The operating frequency is marked on the voltage-controlled oscillator (VCO) module on the rear side of the board. The chart provided in "Servicing Pagers: Frequencies, Coding Formats" (March 1994 issue) indicates the coding language and speed of the various decoder chips. I have not spent enough time to decide the various test points or what they signify in these "old-timers."

Motorola has introduced a conversion for the Bravo programmer that everyone will find valuable. This conversion consists of a new "ground" pin that physically connects to the logic board's negative battery tab and some new software to program the POCSAG "blob-chip." Newer versions of the decoder chip are no

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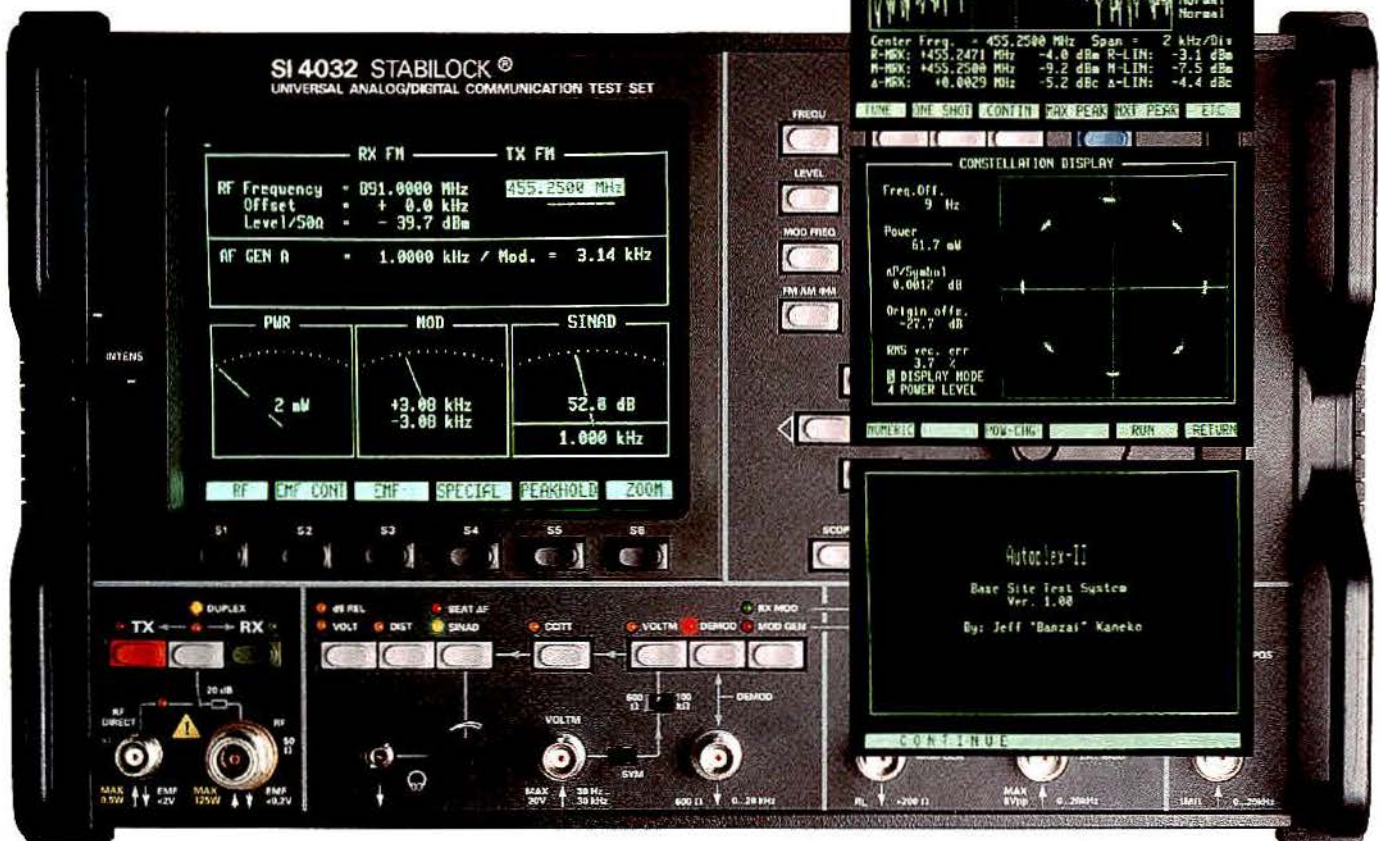
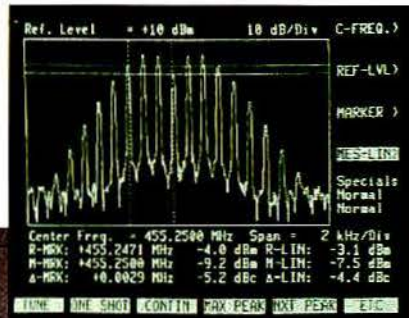
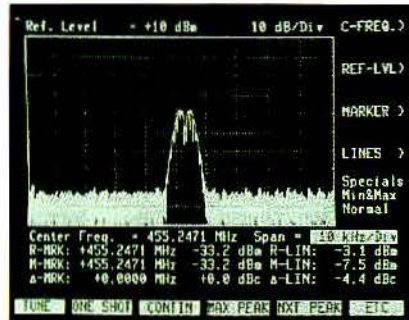
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longer covered with a ceramic "lid"; instead, they are covered with an epoxy-filled "blob." These chips *may or may not* be programmable using the unmodified programmer. Different voltage levels are used to program the codeplugs. Modifications are performed at all Motorola pager service centers.

One further note regarding the "missing page" problem. Everything in the Bravo family of pagers allows a choice

for a function known as "beep on bad data" (BBD on the Bravo). Invariably, I set this function to YES because it defeats the need for a perfect checksum before displaying a message. This is enough to compensate for bad reception associated with signal overlap and weak signals. More on this next edition.

When the pager is set this way, the message display degenerates to a string of Es when the receiver board drifts off fre-

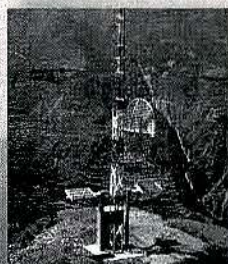
quency or becomes nearly deaf to the transmitters. At the service bench, we either realign the oscillator and check the antenna tuning or replace the entire receiver board with a good one.

Acknowledgement

I would like to thank the management and staff of Toltec Communications Resources, Pasadena, TX, for their help with this project.

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Pager servicing series

Part 1: "Build a Shielded Room," January 1994. (All pagers.)

Part 2: "Build an 'IFFER,'" February 1994. (Bravo, Bravo Plus, Bravo Express.)

Part 3: "Frequencies, Coding Formats," March 1994. (Bravo.)

Part 4: "From Bench to Programmer," April 1994. (Bravo.)

Part 5: "The Receivers," May 1994. (Bravo.)

Part 6: "Elegant Simplicity," June 1994. (Bravo.)

Part 7: "Problems in Paradise," July 1994. (Bravo.)

Part 8: "406MHz-512MHz Receivers," August 1994. (Bravo.)

Part 9: "150MHz Receivers," September 1994. (Bravo.)

Part 10: "Tales Crystal Filters Tell ...," October 1994. (Bravo, Bravo Plus, Bravo Express.)

Part 11: "Microprocessor Board," November 1994. (Bravo.)

Part 12: "Headaches (and Some Aspirin)," January 1995. (Bravo.)

Part 13: "Mixed Signals," February 1995. (Bravo.)

Part 14: "Essential Differences," April 1995. (Bravo Plus, Bravo Express.)

Part 15: "And You Shall Receive Knowledge...," June 1995. (Bravo Plus, Bravo Express.)

Part 16: "The Information Highway," July 1995. (Bravo Plus, Bravo Express.)

Part 17: "450MHz Receiver Boards," August 1995. (Bravo Plus, Bravo Express.)

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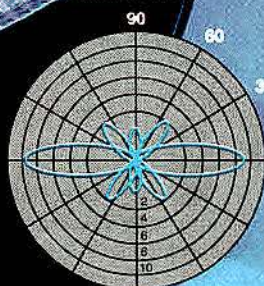
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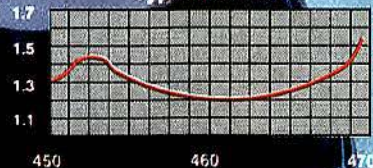
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Removing radio equipment from vehicles

When vehicles are retired from service, their radio equipment often can be salvaged for reuse. Here are some suggestions for removing the equipment and for evaluating its potential for reuse.

By Roald Steen

When a radio-equipped vehicle is taken out of service, the mobile radio equipment must be removed. Along with the radio, other parts of the installation must be disassembled, including the control cable, control head, microphone, antenna and wiring.

Removal is faster than installation—but the procedure may not be pleasant. The vehicle and radio equipment will be dirty and corroded from years of use. Although vehicles usually are brought into the radio shop for installation procedures, equipment removal often takes place at other, less convenient locations.

One option is to remove the equipment in such a way that much of it will be reusable. Usually the radio is in good condition. The control head and control cables might be reusable in another vehicle, too, if they are in good condition.

Another option is to restore the vehicle to its original state for sale or for use in

another application that does not require two-way radio capability.

Disconnect power

The first step is to disconnect all power from the radio equipment. Although many power wires can be removed simply by using the wire cutter, it is important that the pieces of wire remaining in the vehicle be covered with electrical tape. The covering helps to avoid shorting the battery to ground, if the wire tips should come into contact with grounded vehicle parts.

The antenna usually can be reused. Use appropriate wrenches to remove it. If the antenna was mounted through a drilled hole, plug the hole with a rubber plug made for the purpose. They are available from radio parts supply houses.

Do not reuse the coaxial cable. The short length of coaxial cable used in a vehicular installation is inexpensive, and it becomes lossier with use. The loss results from moisture that enters the cable and from the cable being bent and twisted. It may as

well be discarded. Remove the cable by cutting it and then pulling it free.

Some shops reuse coaxial connectors, though the practice may be questioned. Connectors also are inexpensive and their quality is degraded by use. Reuse requires technician time for solder removal. The labor costs more than a new connector. It is better to discard used connectors.

Control cable

The control cable usually can be reused. Inspect it after it is pulled. If it has been subjected to a great deal of wear and tear, and if heat damage from the catalytic converter or exhaust system is evident, the cable should be discarded.

Brackets are subject to corrosion. Inspect each individually to decide whether reuse is advisable. A visibly corroded bracket probably should not be reused because the customer may notice the corrosion. The use of corroded brackets would not reflect well upon your service shop.

The control head is another valuable part that generally is reusable. Look for damage, dirt and paint. Remove marks of wear and tear. A clean control head is desirable because it is the most visible part of the installation.

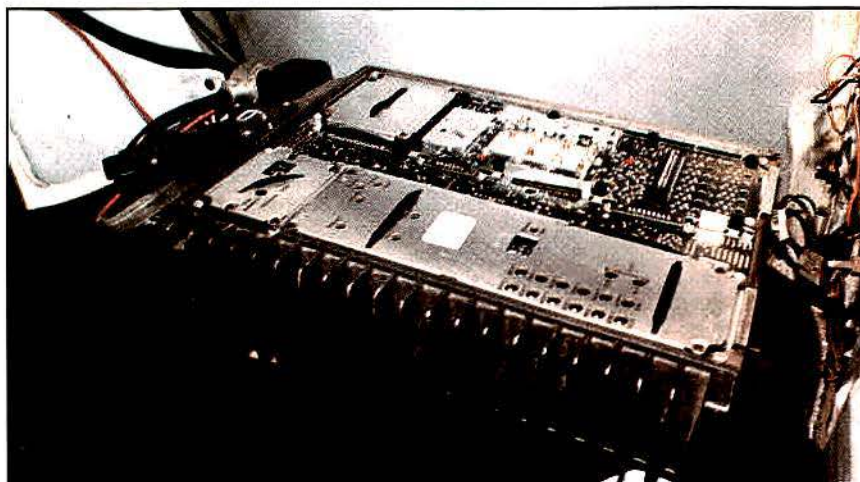
Clean the inside of the control head, making sure connectors are clean and undamaged.

Microphone

The microphone usually is reused, too. But it receives its share of wear and tear. Before returning it to service, clean and test it. Replace chipped or damaged parts.

The microphone connector also is highly visible. If it is corroded or damaged, it is better to replace it. Fortunately, microphone connectors are inexpensive.

Fuseholders are inexpensive, so you



A radio removed from a vehicle taken out of service should be thoroughly checked before reinstallation. As a vehicle often sees little use toward the end of its service life, its radio equipment may have developed unreported malfunctions.

Steen is an electronics instructor and free-lance writer. He has worked as a two-way radio technician, and he lives in Woodbury, MN.

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888TT

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Reusing equipment

If it is in good condition, the following radio equipment can be reused:

- ☐ control head
- ☐ control cables
- ☐ antenna
- ☐ brackets
- ☐ microphone
- ☐ microphone connector
- ☐ radio

It is not advisable to reuse the following equipment:

- ☐ coaxial cable
- ☐ coaxial connectors
- ☐ fuseholder
- ☐ wiring

may not want to reuse a fuseholder, especially if it has held the fuse for the transmitter, which requires a large current.

Most other wiring should not be reused. The few feet of wiring found inside a vehicle does not represent much cost. New wire is less likely to develop points of high resistance.

On public safety vehicles, the siren often is part of the equipment within the responsibility of the radio shop to remove. Remove not only the siren, but also the siren speakers. Inspect the siren and speakers, and clean them before returning them to service. Remove dirt and evidence of damage. A new siren case may be required, if the case shows heavy use. Because the siren is highly visible, it should look clean.

Other equipment to be evaluated may include brackets for mobile data terminals, intercoms and intercom speakers.

Although it is prudent to reuse equipment, it also is prudent to make sure that used equipment is functional and looks right before it is reinstalled in another customer's vehicle.

Testing radios

Radios removed from vehicles to be

taken out of service should be thoroughly tested before being returned to service in another vehicle. The radio may have remained in the vehicle for some time and may have seen little use, allowing it to develop unreported malfunctions. Corrosion may have affected circuit boards and other parts.

Unreported malfunctions tend to occur in vehicles being removed from service because they may be less frequently used, pending replacement. While waiting to be stripped of equipment, the vehicles may be stored in locations less favorable than those for vehicles used daily. Storage locations may become muddy or submerged. Vandals may have had access to stored vehicles and the equipment they contain.

Equipment removed from vehicles that have been submerged may have to be discarded, including the radio itself.

Make sure the new installation looks as new as possible. If you install used equipment and radios, be sure they are clean and present the right appearance to your customer.



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Applications

- Use with any Scanner or Receiver for Off-The-Air measurements (may require internal connection to discriminator for CTCSS and DCS)
- Use with Receiver & PC to automatically survey busy communication channels for tone and code usage
- Ideal for repeater operators to monitor users
- Direct connection to Optoelectronics R10 Interceptor® for CTCSS, DTMF, FM deviation and signal strength measurement system

Features

- Simultaneous off air measurement of 50 CTCSS tones, 106 DCS codes, and 16 DTMF characters
- Six measurement modes
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APCO national conference '95 preview/guide

Welcome to *Mobile Radio Technology's* coverage of the 61st annual national conference and exhibition of the Associated Public-Safety Communications Officials—International. This section is designed to help you plan your time at Macomb Hall in the Cobo Convention Center, Detroit, August 13–17.

Sections include:

- ▶ a map of the exhibit hall on page 36.
- ▶ a list of exhibitors and their booth numbers.
- ▶ a summary of exhibitors' products and services that will be on display. Exhibitors listed are those who submitted information as of press time.

More than 200 public safety communications manufacturers, distributors and service providers will convene at Macomb Hall in the Cobo Convention Center in Detroit. Products on display will include antennas, accessories, automatic vehicle location equipment, batteries, lightning protection equipment, mobile and portable radios, mounts, obstruction lighting, paging equipment, test equipment, towers and

Event: Associated Public-Safety Communications Officials—International

Dates: Aug. 13-17

Location: Macomb Hall, Cobo Convention Center

City: Detroit

Number of Exhibitors: More than 200

Projected Attendance: 6,000

Exhibit Hours: Tuesday, Aug. 15—10:30 a.m. to 5 p.m.
Wednesday, Aug. 16—10 a.m. to 5:30 p.m.

Registration/Hotel Information: 800-949-2726

other wireless- and public safety-related items.

For a rundown on what exhibitors plan to showcase at this year's APCO show, refer to the products and services section beginning on page 44. The names of exhibitors that are also advertisers in this issue are **highlighted in blue ink**. Page

numbers where you can find their respective advertising are also listed.

Refer to the list below of the concurrent seminar tracks that are to be presented at the show. The topics are listed in random order. A daily schedule will be available in the conference pocket guide and from the APCO Conference Department.

Tentative list of seminar topics to be presented at APCO

Information Systems	Telecommunicator Training	9-1-1	Technology Systems	Management & Planning
<ul style="list-style-type: none"> • I Want My MDT • Re-engineering Your Communications System for Mobile Data Panel • Future CAD • Cellular Digital Packet Data • Internet and the Emergency Management Community • Strategic Directions for ARIS/GIS & Telecommunications Integration • From Vehicle Location to Vehicle Information • Case Studies in Information-sharing Using Wide-area networks • Coverage Studies as a Function of Packet Reliability • Achieving Voiceless Dispatch Through Integration of E9-1-1, CAD/RMS and Digital Trunked Radio • Mobile Data, Trunked or Conventional • Cost-effective, Integrated Mapping 	<ul style="list-style-type: none"> • Are You Prepared? • Is American Sign Language Greek or Poor English? • Training Telecommunicators in CO Emergencies • You and the Law in Your Work Place • Discrimination in the Work Place • Use of Video in User Training • Controlling Conflict/Dealing With Difficult People • Line of Duty Death ... Its Effects on Survivors • Using Hearing-impaired Instructors: Alternative Training Methods • Stress Management • Responding Effectively to 9-1-1 TDD Callers • Good Management + Satisfied Workers = A Great Comm Center 	<ul style="list-style-type: none"> • From Inception to Reality, Creating an Educational Video for 9-1-1 • 3-1-1 in New York State • 9-1-1 & Wireless • 9-1-1 Funding and Implementation • The Dispatcher's Role in Community Policing • Climb the Ladder to Success with the Blue-Red-Red Program • In Support of a National Standard: The 9-1-1 Technology Dilemma • The Future of 9-1-1 • PSAP of the Future • 9-1-1 Panel Discussion — Impact of Local Phone Service Competition • The Evolution of the Enhanced 9-1-1 Network 	<ul style="list-style-type: none"> • Introduction to Intelligent Highway Systems • P/S Standards, Worldwide Impact on Land Mobile Applications • Technology, the NYPD Approach • Maximizing Capacity—Winning the Battle of Increased Spectrum Demand vs. Lack of New Spectrum • Integrated Solutions for State-wide Communications Systems • Michigan's Public Safety Communications System • Advantages of Using a Systems Integration Design Approach • Computer Modeling Support for a Complex Trunked Radio System Design • From Analog to Digital: Fear-proof Migration • Designing Effective Building Safety Protection Systems • Communications Contingency Plan 	<ul style="list-style-type: none"> • Florida Statewide Public Safety Communications Mutual Aid Plan • Process Improvement Methodology Applied to 21st Century Policing • Successful Communication in a High-risk Environment • Managing from the Heart • Cases and Commentary—A Legal Update on Employment Issues • Essentials of Effective Written Communications II • Developing Policies & Procedures That Measure Performance • Benchmarking for Quality Improvement in Fire Communications • Assimilation of an 800MHz System into a Multi-agency Operation

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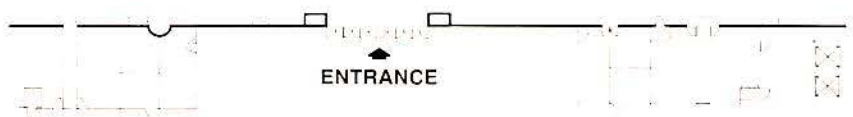
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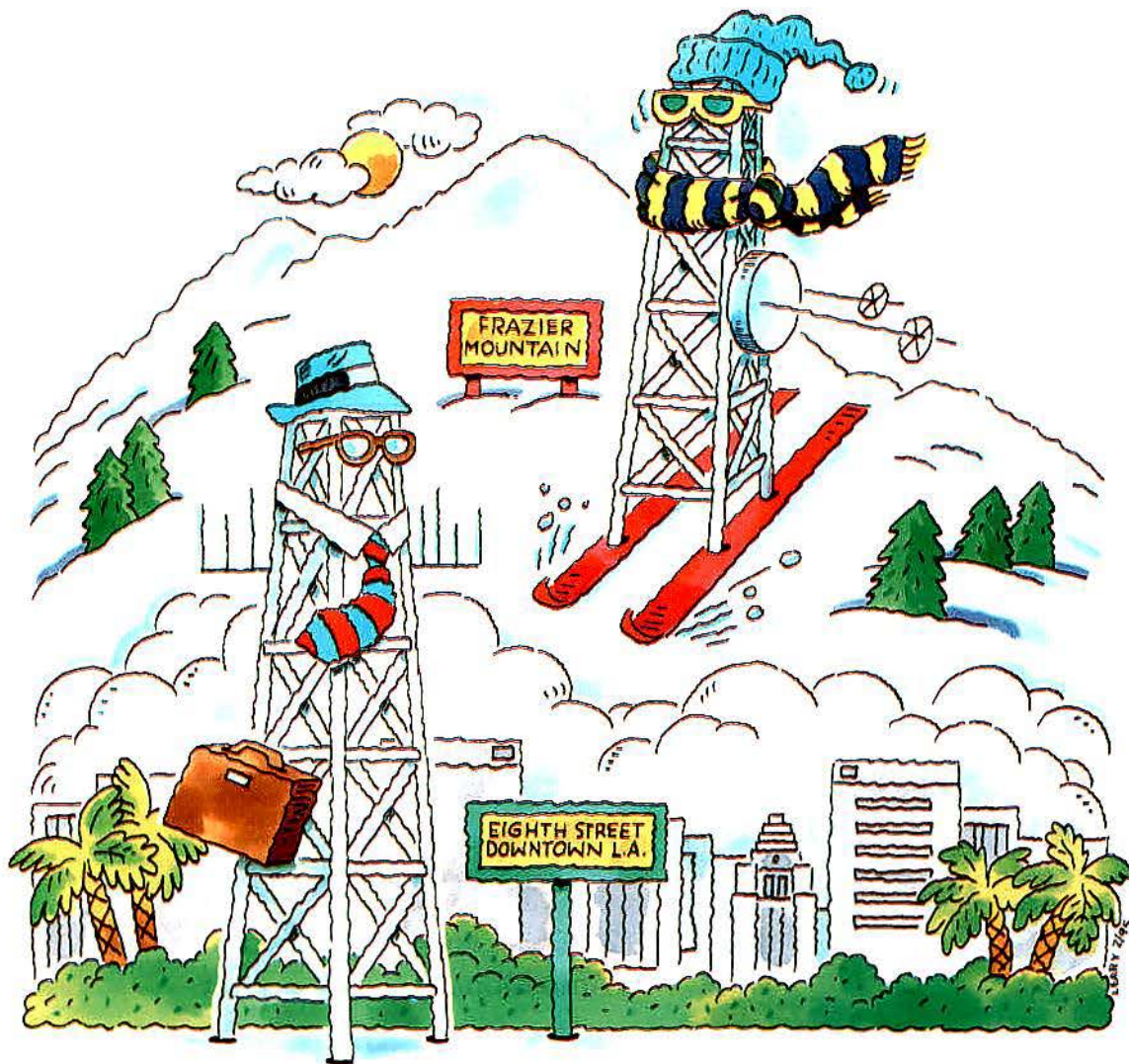
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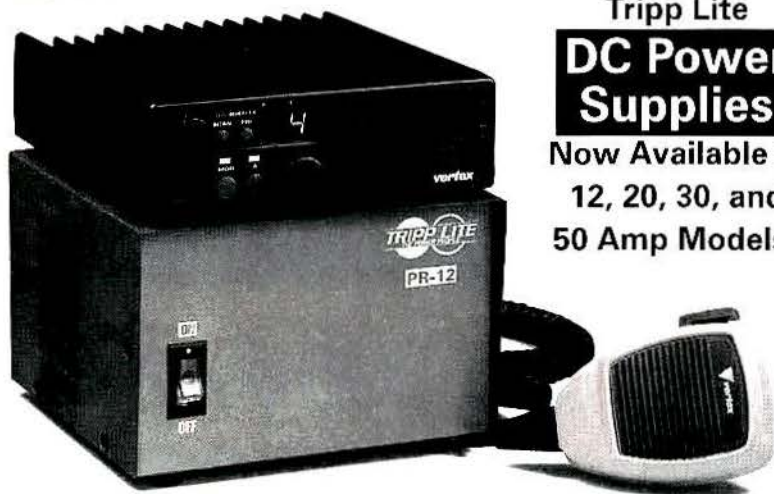
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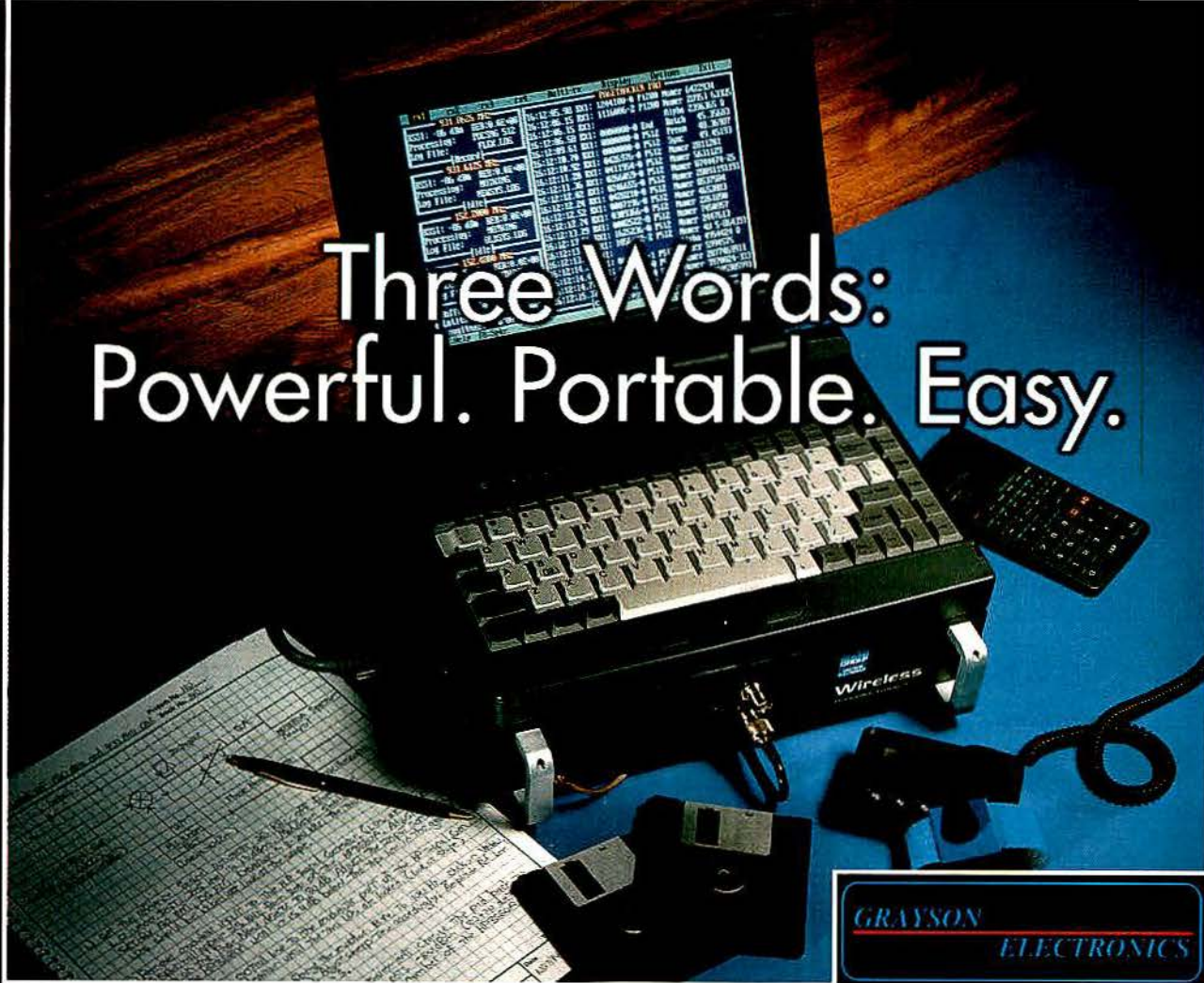


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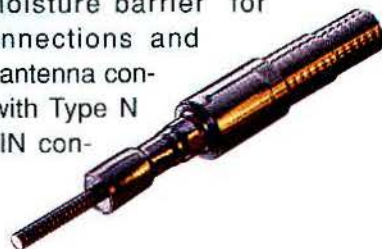
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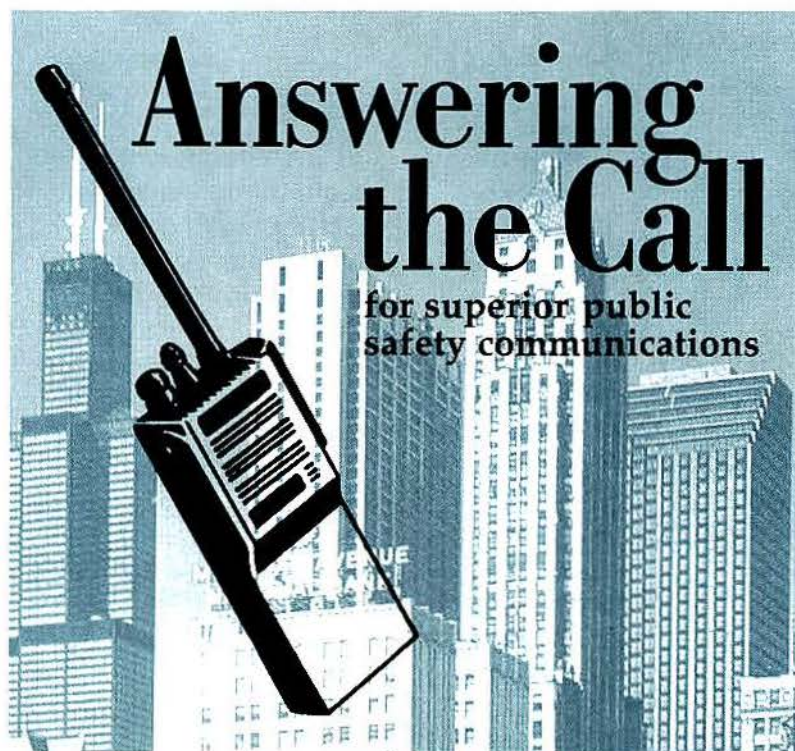


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 TX RX Systems (630)
 UCS (1236)
 Uniden America (939)
 Unisys (633)
 UTC Service (932)
 Valmont Industries (613)
 Valor Systems (819)
 Vega, a Mark IV Co. (1000)
 VFP (1118)
 Watson Furniture Systems (420)
 Westinghouse Electronic Systems (1232)
 Whelen Engineering (200)
 Winnebago Industries (236)
 WirelessWorld magazine (318)
 Yaesu U.S.A. (846)
 Zetron (706)



CML Technologies proudly introduces COM-STAR, the next generation of Emergency Radio Dispatch systems for medium to large urban centers. The innovative COM-STAR system is the result of years of experience and our all-encompassing commitment to build products that exceed our customers' expectations. Fully digital architecture throughout gives COM-STAR an unsurpassed level of flexibility that allows us to customize and adapt the system

to meet your specific emergency communication requirements.

Thanks to the expertise and commitment of CML's skilled customer service and field engineering departments, our customer support package includes in-depth user training and complete around-the-clock technical support.

Call CML Technologies today to discover how the COM-STAR's leading-edge performance is answering the call for superior public safety communications.

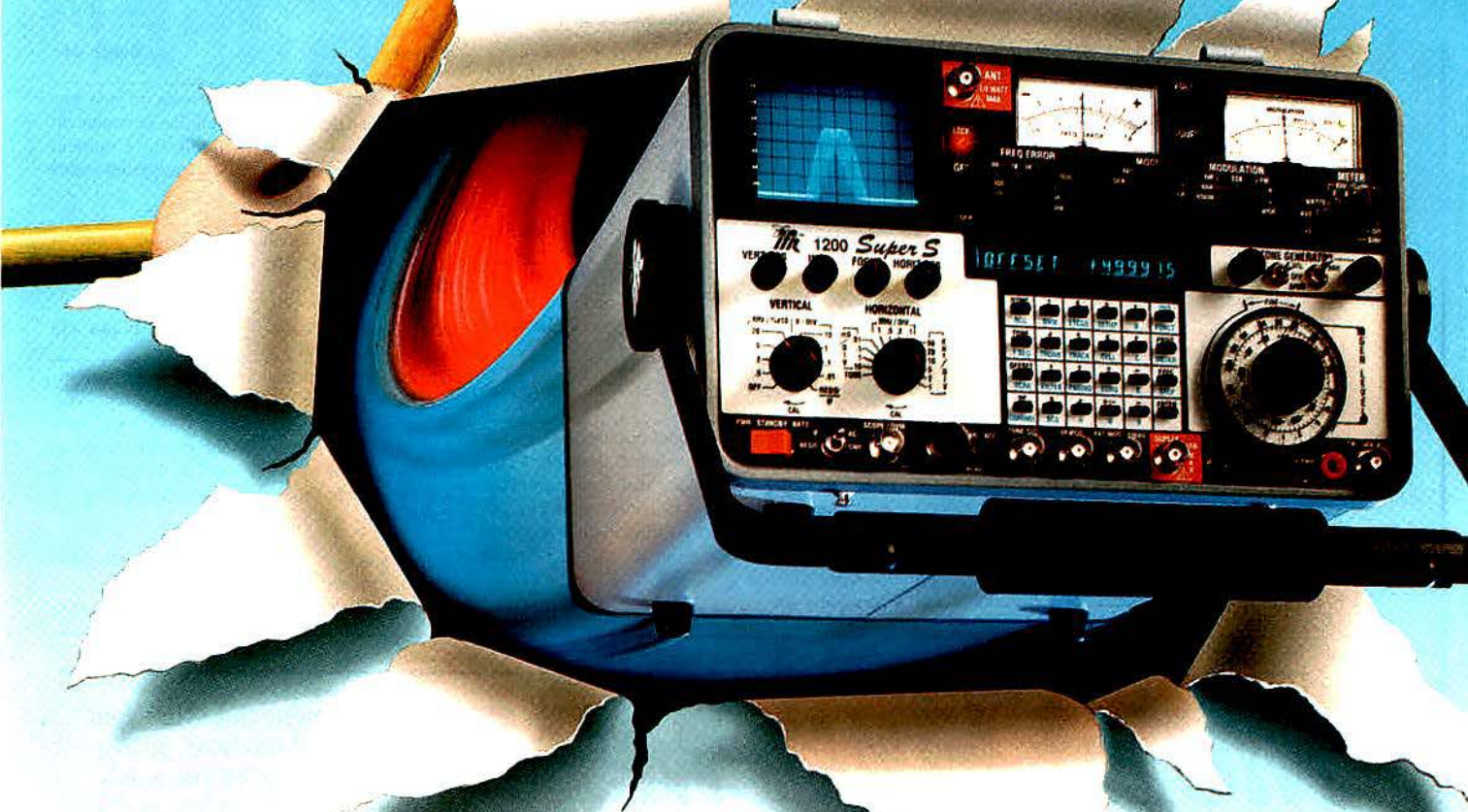


CML TECHNOLOGIES INC.

(404) 266-8315 USA

(819) 778-2053 Canada

**Why Tinker Around
When it Comes to Your
Communications Testing**



THE NEW IFR 1200 SUPER-S

A New Breakthrough In Analog Service Monitors

Now, the ease of use found in analog service monitors is combined with some of the best features available in the new digital instruments. IFR presents the new 1200 SUPER-S, providing to you the best of both worlds. Its incredible features such as storage of 99 RF frequencies, direct channel selection for cellular, trunking and cordless telephones, easier programming of 2-tone and 5/6-tone signaling, duplex offset frequencies up to ± 49.9975 MHz and cable fault location with the optional tracking generator make the 1200 Super-S a highly versatile instrument.

Of course, the Super-S still provides all the standard features previously found in the FM/AM-1200S such as analog and digital meters for convenient operation regardless of the lighting conditions, 1 GHz RF generator, 1 kHz and variable frequency audio generators, duplex operation, 2 μ V receiver, 150 W

power meter, 1 GHz spectrum analyzer, 1 MHz oscilloscope and RS-232 interface.

The list of options is as impressive as the new features. Options such as European analog signaling, tracking generator with cable fault, CLEARCHANNEL LTR®, AMPS cellular and ETACS cellular are available at time of delivery or may be retrofitted at a later date by IFR's customer service department.

If you require high quality communications service monitors to install or maintain systems for trunking, paging, land mobile or cellular and you provide field service as well as in-shop service, then contact IFR Systems at 1-800-835-2352 for a demonstration.



IFR SYSTEMS, INC.



10200 West York Street / Wichita, Kansas 67215-8935 U.S.A.
Phone 316/522-4981 / 1-800-835-2352 / FAX 316/522-1360

Products and services

For more information on the products and services listed, fill out and return the Fast Fact Card on page 109. See sample below.

FAST FACT CARD

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Circle 999

Circle 1000

XYZ Systems **Booth 999**
Existing products
 Galaxywide paging; satellite rental; multilingual billing software.
New products
 Coin-size pager. This unit operates on ambient heat and needs no batteries.
Circle 900 **See ad page 845**

Information listed was supplied by the exhibitors, was accurate as of press time and is subject to change.

Advanced Signal **Booth 123**
New products
 Surveillancepro is part of a surveillance system for the real-time reception, decoding, display and file logging of high-speed radio paging messages.
Circle 250

Alcatel Network Systems **Booth 511**
Existing products
 MDR-6000 microwave radio; MDR-4000e microwave radio; 1603 SM fiber-optic transport; OC-3 multiplexer; 1301 NM network manager.
Circle 251

Allen Telecom Group **Booth 700**
Existing products
 Vehicular antennas for land mobile and cellular use from the Antenna Specialists division; VHF, UHF, trunking and cellular base station antennas plus site equipment and filters from the Decibel Products division; and RF distribution products for trunking systems from the Allen Telecom Systems division.
New products

Trunking MicroLite: SP9616-OTR; trunking Prism Plus: DBE40A1-CTE; trunking MicroFill amplifier: MF1H1N5N5-AA.

Circle 252

See ad IFC

Antenex **Booth 411**
Existing products
 Mobile, portable and base antennas for two-way radio, data telemetry and cellular communications; special custom antenna development projects; made-to-order coaxial assemblies in any volume.
New products
 Voyager series aluminum omni base antennas UHF—unity and 3dB; VHF—unity and 3dB.
Circle 253

ASC Telecom **Booth 423**
Existing products
 DL-2 digital multi-channel system records eight-32 channels using DAT (digital audio tape) cassettes with 55-hour capacity; DS-4 emergency call repeater provides simultaneous recording and playback, operates on 12Vdc supply for mobile vehicle use and is maintenance free.
Circle 254

Auto-Trac **Booth 1404**
Existing products
 FleetService automatic vehicle location system

MULTI-EQUIPMENT MOUNT SOLUTIONS

Is equipment cluttering your vehicle? SDI modular, airbag-friendly mounts let you safely arrange your in-car office, public safety or commercial vehicle equipment. And every SDI mount is just one fast, toll-free call away at Hutton.



SDI 720



SDI Mobile Office Kits



Dallas, Texas
800-442-3811

Atlanta, Georgia
800-741-3811

Denver, Colorado
800-726-6245

Seattle, Washington
800-426-2964

Toronto, Canada
800-265-8685

Mexico
(95) 800-866-3811



Circle (36) on Fast Fact Card

"In my business, seconds can make the difference between life and death."



"In the critical situations I face every day,
I can only afford to work with the most
reliable communications equipment.
Kenwood 2-Way radios give me constant,

immediate communication every time. On an emergency call,
that can make all the difference! With so many risk factors to
consider, I don't take risks with my two-way equipment."

CALL 1-800-950-5005

Get a free pocket-sized screwdriver set with a
dealer demonstration.* Call 1-800-950-5005
for a Kenwood Representative nearest you.

TEAM UP WITH KENWOOD



*while supplies last

The TK-630, 730, 830 Series
mobiles can be customized for
many applications, including
dual band and dual head
configurations. And unlike other
radios requiring expensive add-
ons, the TK-630, 730, 830
Series come with these
standard features:

- Built in Public Address
- Backlit LCD and Buttons
- Assignable Buttons
- Speaker Control
- 12 Character Alphanumeric Capability
- Single or Dual Priority Scan
- Home Channel
- Talk Around
- and many others...

The TK-230SP and 330SP
portables have been engineered
to sustain the most rigorous
demands of the public safety
professional. These advanced
generation VHF/UHF synthesized
portables are produced with
rigid adherence to the highest
quality control standards, and
come with these standard features:

- Microprocessor Controlled Scan
- Synthesized 100 Channel Capability
- Alphanumeric, Multifunction LCD Display
- Built-In QT and Digital QT
- Five-Watt RF Output
- MIL-STD 810 Approved
- Wide Band Frequency Spread

TEAM 2 WAY
KENWOOD

P.O. Box 22745, Long Beach, CA 90801-5745 • (310) 639-4200 or fax (310) 761-8246

For information on our complete turn-key trunking systems, contact
Kenwood Systems Group at 1-800-TRUNKING

Visit us at APCO, Booths 1230, 1231, 1330 & 1331.



Circle (37) on Fast Fact Card

(AVL)—AVL/GPS.

New products

Geo-Trac; Secure-Trac; Cell-Trac; Windows mapping systems; CAD interface; FleetService control center.

Circle 255

AVL Information Systems Booth 837

Existing products

Vehicle information system III (VIS III).

Circle 256

Avtec

Booth 903

Existing products

DSPatch digital integrated radio/telephone console system that is capable of supporting 32-1,024 lines or operator workstations.

New products

DSPatch 32 is a small console system with most of the same features as DSPatch but limited to 32 lines or workstations.

Circle 257

See ad page 50

Badger Technology

Booth 315

Existing products

Network fault management, supervisory and control systems that incorporate a universal monitoring that employs a variety of protocols. Used in virtually any microwave, fiber and/or central office application.

Circle 258

BK Radio (Bendix/King)

Booth 212

Existing products

VHF and UHF portables and mobiles; dual transceiver mobiles; signaling devices; full line of accessories.

Circle 259

Buford Goff & Associates

Booth 524

Existing products

Communications systems engineering for the implementation of land mobile radio, dispatch center, microwave radio, fiber-optic, mobile data and telephone switching systems.

Circle 260

C.E.T.

Booth 1026

Existing products

Airsite propagation study; CET3500 3-D terrain viewer; fresnel zone study—microwave point-to-point; FCC license information.

Circle 261

Call One

Booth 1100

Existing products

Radio console and telephone headsets; repair of radio console and telephone headsets.

New products

GN Netcom-Advantage I and II; ACS Stratus Ultra; Inovonics 900MHz noise-canceling cordless headset.

Circle 262

Cast Products

Booth 100

Existing products

SH2025 police vehicle speaker; SH5025 police utility speaker; E10100 multi-flasher; CO4521-

1-2 light housings.

New products

EX2100 series emergency lighting.

Circle 263

Cellular & Mobile International Booth 318

Existing products

Published bi-monthly, *Cellular & Mobile International* provides decision-makers with articles that examine the technologies, applications and equipment of the international wireless communications industry. The circulation of 10,000+ reaches system operators, dealers, distributors, engineers, large-volume end-users (including public safety buyers) and manufacturers around the world, including European, Asian and Latin American markets.

Circle 264

Cellular Business

Booth 318

Existing products

The first and leading trade publication for the cellular telecommunications industry, *Cellular Business* is published 13 times a year for cellular system operators, dealers, retailers, resellers, sales agents, distributors, engineers, large-volume end-users and manufacturers. The editorial addresses both technological developments and marketing concerns, with columns focusing on news, new products, sales strategies and data. Visit our booth to pick up a copy and sign up for your free subscription.

Circle 265

TWO-WAY RADIOS FROM UNIDEN... NOW AT HUTTON

Uniden UHF and VHF conventional radios are in-stock at Hutton. Now you can receive top-quality radios with the hassle-free, friendly service Hutton customers count on! We're building a nationwide network of Hutton dealers for Uniden products. Interested? Call us today for dealership requirements!



NEW SPU454
Full-Featured Portable



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800-442-3811

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Denver, Colorado
800-726-6245

Seattle, Washington
800-426-2964

uniden

Circle (38) on Fast Fact Card

TWO-WAY REPLACEMENT

Batteries

SINGLE & MULTIPLE

MasterChargers®



Presenting our broad range of communication Battery Chargers (single and multiple units). In addition, we manufacture the largest assortment of Two-Way Communication Batteries in the industry, with the Highest Quality, utilizing SANYO cells in 90% of our battery packs.

MANUFACTURED IN U.S.A. BY
W & W ASSOCIATES

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IN U.S.A. & CANADA CALL TOLL FREE (800)221-0732 • IN NY STATE CALL (516)942-0011 • FAX (516)942-1944

ALL SPECIFICATIONS & PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

Circle (39) on Fast Fact Card

Celwave**Booth 226****Existing products**

Antenna system products, including base station antennas, combining products, RMCs, filter products, bidirectional amplifiers, cable and connectors; 800MHz products: PD10099 sector antenna, PD10183-1 omni, WJD 860-55 waveguide trunking combiner, RMC 800-8 trunking multicoupler, 48561-N BDA; 450MHz products: TJD460-5 combiner, PD526-4 duplexer, RMC460-8 receiver multicoupler, PD688S yagi antenna; 150MHz products: PD440 exposed dipole antenna, BA1012 omni, PD5085 compact duplexer.

New products

PD5318 trunking duplexer; Cellite antennas; DSC products and services; MicroBDA.

Circle 266

See ad page 18-19

Centurion International**Booth 1123****Existing products**

Full line of replacement antennas for all portable radios; a selection of batteries for most popular land mobile portable radios; cross reference guide to antennas and batteries.

New products

Replacement antenna for Motorola flip phone, Centurion model number CXS-MFP.

Circle 267

See ad page 9

CeoTronics**Booth 443****Existing products**

PTT and vox headsets, lightweight and high

noise; Contact Com. Ear Mike 475 & 575, throat mike systems; Active Ear Defender.

New products

TC 917 UHF wireless headset; Ear Mike 575.

Circle 268

CNI Technologies**Booth 900****Existing products**

ECS-1000 and Rescue-Star fully digital ANI/ALI controllers.

New products

Com-Star PC-based radio dispatch console system.

Circle 269

See ad page 42

Codan**Booth 402****New products**

9360 HF transceiver, 125W PEP, 400 channels with selective call, emergency call, scanning, remote control head and beacon mode.

Circle 270

Combined Technologies**Booth 525****Existing products**

Smartswitch II remote comparator display; TSAM transmitter steering units.

New products

MCN series modular remote comparator displays.

Circle 271

See ad page 73

Communications Data Services**Booth 302****Existing products**

RFCAD real world propagation software package that uses digital terrain data to provide users

with RF signal propagation analysis.

Circle 272

See classified ads

Comprehensive**Booth 836****Law Enforcement Systems****Existing products**

Computer-aided dispatch with mobile data computers; police and fire records management; mapping.

New products

Dispatchers' graphical "Windows" workstation; GUI status monitor.

Circle 273

Comsearch**Booth 424****Existing products**

Communications engineering services for the mobile, microwave, satellite and PCS industries; interference engineering software, terrain digitizing, propagation analysis, interference analysis, network design, field studies, licensing assistance, demographic studies and market reports.

New products

Spectrum Sharing software, which analyzes interference between PCS and microwave, enabling the microwave licensee to determine the extent to which spectrum may be shared and the impact of PCS on any given market.

Circle 274

Comverse Information Systems**Booth 224****(formerly Comverse/Magnasync)****New products**

True SNR Voting With DSP



SNV-4 Signal-To-Noise Voter

The SNV-4 provides 4-channel voting as well as DSP Noise Reduction and DSP Voice Recognition Squelch on each channel. Other models have capacities from 2 to 64 channels.

NEW!!! DDU-10 Digital Delay Unit

Provides up to one second of precise audio delay to eliminate first syllable clipping in mobile radio communications systems.

Features:

- Uses 4 independent Digital Signal Processors to vote the best channel.
- Operates from 2-wire audio inputs.
- Measures signal-to-noise ratio (SNR) of speech in input audio of each channel.
- No guard tones required for COR generation or for SNR measurement.
- Offers repeater transmit control without requiring COR input signals.
- Transmit Control Option commands the proper transmitter to follow the voted receiver.
- Also performs with conventional voting receivers.

For more information, contact:



JPS Communications, Inc.

P.O. Box 97757, Raleigh, NC 27624-7757

(919)790-1011 FAX:(919)790-1456

Compuserve: 71673.1254 Internet: jps@nando.net

SAME PHYSICS. SIMILAR PARTS. NEARLY IDENTICAL FEATURES. RADICALLY DIFFERENT UPBRINGING.



THERE'S MORE TO
A RADIO COMMUNICATIONS
SYSTEM THAN A WELL KNOWN NAME.

HERE'S WHY THE MULTI-NET® II SYSTEM STANDS OUT

FROM THE COMPETITION: ▲ Multi-Net II combines innovation and

over 70 years of E.F. Johnson radio experience to satisfy the most demanding system

managers. Multi-Net II offers the same capabilities as other systems—like unique IDs, networking

with auto-registration, and simulcasting—plus unique technology such as dynamic channel allocation, and a clear

path to our Jade™ and APCO-25 digital environments. Multi-Net II systems are built with a different attitude as well, by a

team that believes in working with customers, not dictating to them. If you're looking for a new radio system, look beyond the name to

the technology and people that stand behind it. Call us at 1-800-328-3911 ext. 6380. ▲ INTELLIGENT CHOICES FOR A WIRELESS WORLD.™



Systems

©1995 E.F. Johnson Co.

Circle (41) on Fast Fact Card

DVL Ultra series that includes the Ultra System for recording as many as 1,000 channels per system; Ultra Tower for as many as 32 channels and the Ultra portable voice recorder.
Circle 275

Concept Seating **Booth 400**

Existing products _____
Pro Copper low-profile consoles for radio and other equipment mounting; Pro Copper duty chair for high-intensity use, i.e., 9-1-1 dispatch; Pro Copper vehicle seats for safety, health and comfort.
New products _____
Pro Copper 24-hour duty chair.
Circle 276

Concepts To Operations **Booth 704**

Existing products _____
Public safety telecommunications and information systems consulting services: conventional radio, 800MHz, microwave, E9-1-1, PSAP consolidation/design.
Circle 277

Cycomm **Booth 426**

Existing products _____
PrivaFone 200 series voice privacy products; The Slice detachable hand-held privacy device for the Motorola MicroTac cellular phone; CPU 300 privacy unit for a variety of mobile phones; TPU 300 telephone privacy unit.
New products _____

The Slice HPU 350/5 scrambler for MicroTac phones.
Circle 278

D&L Two-way Wholesale Distribution **Booth 1127**

Existing products _____
Full Ericsson two-way radio line.
New products _____
D&L innovations (system enhancements).
Circle 279 **See classified ads**

Daniels Electronics **Booth 1239**

Existing products _____
VHF-AM/VHF-FM/UHF/800MHz/900MHz radio products for repeaters, base stations, rural telephones and ground-to-air systems.
Circle 280

Data Critical **Booth 1428**

New products _____
Image APB
Circle 281

Dataradio **Booth 803**

Existing products _____
VIS (Vehicular Information Solutions) products for mobile data applications; RF modems for AVL/GPS and mobile data applications.
New products _____
PCVtrak for tracking small fleets of vehicles with datalink equipment supplied by Dataradio.
Circle 282

DataVision **Booth 709**

Existing products _____
DataVision Head-Up Display (HUD) allows officers to receive crucial information from MDTs and radars without taking their eyes off the road.
Circle 283

Datumtech **Booth 1415**

Existing products _____
Turnkey AVL systems, mobile data terminals and computers.
New products _____
Small fleet AVL system.
Circle 284

Dealers' Product Source **Booth 318**

Existing products _____
This "special event" tabloid from the publishers of *Mobile Radio Technology* and *Cellular Business* delivers 100% product coverage to a unique audience of wireless communications dealers and retailers.
Circle 285

Dictaphone **Booth 815**

Existing products _____
Digital communications recording systems, including Prolog and Guardian.
Circle 286

Dispatch Products **Booth 543**

Existing products _____
Q00 series modular steel consoles; RPS series modular acoustic paneled workstations.

DSPatch—THE WORLD'S MOST ADVANCED DIGITAL SWITCH FOR VOICE COMMUNICATIONS



Utilities, airlines, railroads, public-safety, military and other government agencies worldwide have come to rely on Avtec for advanced, high-capacity console solutions for integrated radio/telephone systems. DSPatch is a color touchscreen console system that employs Digital Signal Processors (DSP's) at every line and workstation. Its distributed architecture ensures instant responses, even in large systems. DSPatch may be configured to support from 32 to 1,024 external lines or operator workstations.

FEATURES INCLUDE:

- ◆ User configurable screens
- ◆ Conventional or trunked radio
- ◆ ANI with call queue
- ◆ Multi-format paging
- ◆ Simultaneous conferences
- ◆ Many more

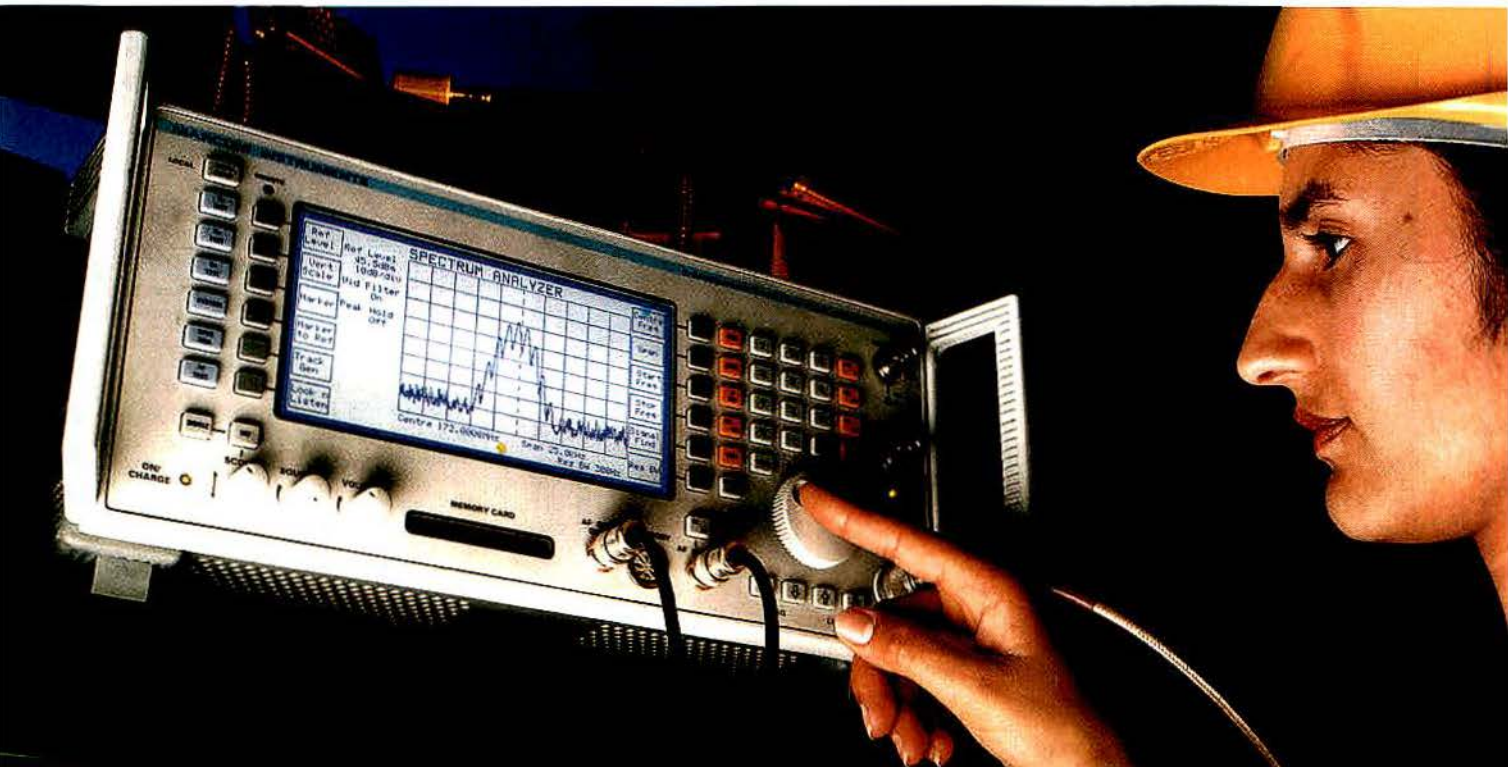
DSPatch32, a 32-port system, is available for smaller applications.

Call, fax or write for additional information or a budgetary proposal.

Avtec

4335 Augusta Highway
Gilbert, SC 29054 USA
Phone: (803) 892-2181
FAX: (803) 892-3715

TestMate.



The new **Marconi 2945 TestMate**; the lightest, fully featured, radio test set available.

No matter what size your business, the new Marconi TestMate radio service monitor is the perfect partner. At just 11.4kg (25lb), TestMate is a complete bench of instruments in a single lightweight unit.

The easy to use interface has been developed from the proven Marconi 2955. Many of TestMate's standard features are options with other testers, including the fastest spectrum analyzer in its class.



A fast bright display update allows adjustments to be made with 'live' signals while a perfect combination of soft and

hard keys provides flexibility and instant access to all functions.

TestMate makes cellular

testing faster than ever and its rugged design makes it best for field tests as well as in the workshop.

Naturally the lightest, fully featured radio test set available is backed up by the best service support. For more about TestMate contact your local Marconi Instrument office.

Marconi
Instruments

Marconi Instruments Inc. 3 Pearl Court, Allendale, NJ 07401 Tel: (201) 934 9050/1 800 888 4114 Fax: (201) 934 9229
In Mexico: Telegroup S.A. De C.V. Tel: 5 398 3889 Fax: 5 362 0273

New products

Ergonomic workstations.
Circle 287

Dynamic Instruments

Booth 408

Existing products

DI-934 digital communication recorder workstation.

New products

DI-939 DAT digital communication recorder.
Circle 288

E.F. Johnson

Booth 615

Existing products

Multi-Net II enhanced wide-area trunking system—Summit DM 800MHz and 900MHz mobile radios, Viking CK/CM 800MHz and 900MHz hand-held radios, Summit QX 800MHz repeaters; For VHF and UHF conventional systems—Challenger series mobile radios, Avenger SE hand-held radios.

New products

For Multi-Net II systems—Viking CR full-duplex 800MHz handheld, Avenger SK 800MHz handheld, Summit dispatch console.

Circle 289

See ad page 49

Emergency Medical Services Magazine

Pub. bin

Existing products

One-year subscription to EMS Magazine; EMS Trivia 2 & 3 game with 1,000+ questions; "Tricks of the Trade" video; *The Best of Case Review*, Volume 1.

New products

"Sexually Related Trauma" video; "Geriatric Emergencies" video; *Patch Exchange* newsletter (by subscription); EMS: *The Screen Saver* computer software.

Circle 290

Emergitech

Booth 1407

Existing products

Enhanced 9-1-1 CPE; mapping and addressing; computer-aided dispatch; digitized mapping; law enforcement, jail and fire records management.

New products

Digitized imaging; MDTs; AVL.

Circle 291

ERI—Electronics Research

Booth 1112

Existing products

Guyed towers to 1,200 feet in height; self-supporting towers to 500 feet; emergency towers to 300 feet; tower and antenna installation service.

New products

Lightning Spur lightning dissipation system; S.K.I.P. Site Keeper Integrated Pager surveillance system; RFSS lockout/tagout energy isolation device for antenna systems.

Circle 292

Eriesson

Booth 1206

Existing products

Enhanced Digital Access Communication System (EDACS) that features voice and data trunking; a variety of mobiles and portables are available to complement the system.

Circle 293

See ad page 59

Eventide

Booth 427

New products

VR 240-III 24-channel digital logger; VR 204 4-channel digital logger; VP 204 digital playback unit; VP 244 digital playback unit; ECW40 digital clock and reference.

Circle 294

Fleet Safety Equipment

Booth 201

Existing products

FS 1200 series equipment organizer; PCC-6P and 10P series power control centers; complete police cruiser turnkey package.

New products

FS 3200-M and FS 3200-V console; FS-PST-CV and FS-PST-CC prisoner transport seats.

Circle 295

Gamber-Johnson

Booth 234

Existing products

MC5-100 series; Notepad; Mission Control consoles; Mission Control accessories.

New products

Mission Control three-piece bases for police vehicles.

Circle 296

See ad page 60

GE Capital Public Finance

Booth 508

Existing products

Lease purchase financing information.

Circle 297

What was
Motorola
thinking about
when we created
the R-2600?

You.

Your needs. Your daily applications. Your continual probing...for accuracy. Reliability. Ruggedness. And efficiency.

The R-2600 Communications System Analyzer is flexible. From basic two-way radio testing to paging, cellular and other applications, this platform allows you to expand your capabilities quickly, easily and affordably. Priced from \$10,950.*



Call Communication Test Equipment today at:

800-505-TEST



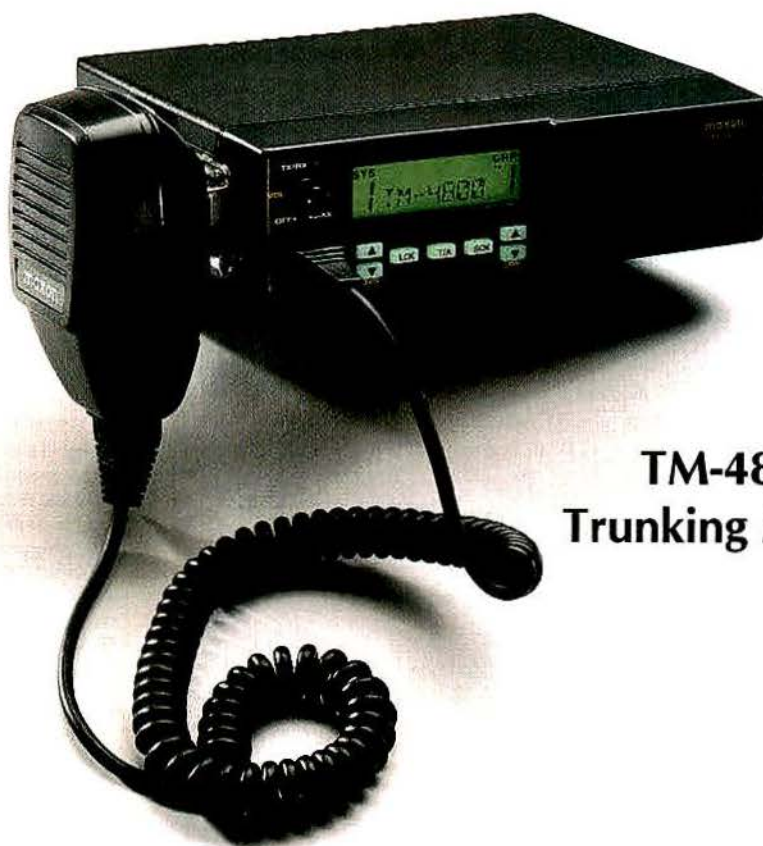
MOTOROLA

*As low as \$240 per month on a 5-year lease, subject to credit approval.

Circle (44) on Fast Fact Card

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Trunking Mobile**

The Smart Money Buys Maxon.

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A World of Communications

Call: 1-800-821-7848, Ext. 606

Circle (45) on Fast Fact Card

Government Technology

Booth 937

Existing products _____
June issue *Government Technology Magazine*, which focuses on: electronic commerce, electronic data interchanges and modems; *Desktop Buyers' Guide*; *GIS Resource Guide*.
Circle 298

¡Habla!

Booth 502

Existing products _____
Spanish language video tutor program that is equivalent to a two-semester college course—16

hours of video and 15 hours of audio plus 4 workbooks.

New products _____
Compact Spanish video tutor program—eight hours of video and two workbooks.
Circle 299

Harris Farinon

Booth 646

Existing products _____
DVM6/10-8T digital microwave radio; DVM6/18-45 digital microwave radio; StarScan network management system.

New products

MegaStar 2000.
Circle 300

HTE Public Safety

Booth 204

Existing products _____
Public safety software solutions, including CAD, RMS, E9-1-1, LEADS/NCIC, mapping and AVL.
Circle 301

IFR Systems

Booth 1015

Existing products _____
Full line of products, including communications service monitors, RF and microwave spectrum analyzers.

New products

COM-120B service monitor with EDACS and ClearChannel LTR trunking and split-screen spectrum analyzer.

Circle 302

See ad page 43

Institute for Disabilities

Booth 1102

Research and Training

Existing products _____
9-1-1 training package.

New products

"Hot Sheet" of critical information that TDD users can keep by the phone and use as a reference in emergencies.

Circle 303

Kenwood Communications

Booth 1230

Existing products _____
TK-250 VHF highband (150MHz-174MHz)/TK-350 UHF (450MHz-512MHz) compact portables; TK-630/TK-730/TK-830 series synthesized mobiles, with dual-head remote and dualband remote configurations, also single-head remote control configuration.

New products

TK-930HDK2 (800MHz mobile) and TK-430K4A (800MHz portable) are NPSPAC-compatible models of 800MHz products.

Circle 304

See ad page 46

Kenwood Systems Group

Booth 1230

Existing products _____
Design, integration and manufacture of UHF, 800MHz and 900MHz trunked radio systems, the TKR-9300S (800MHz) and TKR-9301S (900MHz).

New products

TKR-9300S 800MHz NPSPAC repeater system.

Circle 305

See ad page 46

LDV/Lynch Diversified Vehicles

Booth 1225

Existing products _____
Custom specialty vehicles for police, fire and rescue: communication/command centers, mobile precincts, tactical units, surveillance vans, B.A.T. mobiles (blood alcohol testing), HazMat, and dive/rescue.

Circle 306

Leach Mounce Architects

Booth 820

Existing products _____
Law enforcement, detention, fire and communications facility and forensic lab design. Services include needs assessments, programming, master planning, space planning, site analysis, feasibility studies, architectural design, interior design, construction contract documents and construction administration.

Circle 307

REMEMBER WHEN IT USE TO TAKE 100 MILES OF WIRE TO GET A PHONE? ...Now all it takes is an **SR-20!**

The new SR-20 radio-telephone system utilizes award-winning, fully synthesized RF modules from **Motorola™** and is ideal for voice/fax or data transmission up to 14.4 kbps. TELEPOINT's SR-20 can operate as a phone-line extension, replacement for lease lines or improve satellite/microwave last mile connectivity assuring 100% extended duty cycle operation, delivering the best in companded audio with uninterrupted clarity in the harshest environments.

Programmable RF power and frequency make the new SR-20 the most versatile and cost-effective communications solution on the market today. For the clearest, in point-to-point and multi-point wireless connectivity, experience TELEPOINT...



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We Manufacture Excellence!

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1022 S. La Cienega Blvd. Los Angeles, CA 90035

Circle (46) on Fast Fact Card

NORTHSTAR COMMUNICATIONS

Because money matters . . .

Call Us First.

In the world of communications, the failure of a radio system can put a company out of business. And in today's competitive world, everything revolves around communications. No one understands this better than the employees of Northstar Communications. From the simplest repair work to the most complex installation, Northstar Communications is able to meet all of your communications needs.

We offer a variety of services, including:

- Radio site repair work
- Cable maintenance service
- System design
- Complete turnkey installation

For more information or for a quote, please contact Jonathan Amonett or Harry Lewis at 1 (800) 606-7437.

Northstar Communications

*15330 Anacapa Road, #3
Victorville, CA 92392
(619) 241-1950 • Fax (619) 241-1929*

Lux Steel**Booth 1120***Existing products*

Office chairs: Continua series; Advantage I series; Task Plus; Task Plus II.

New products

Office chairs: intense-use Advantage I XL L128-12; intense-use Task Plus XL 12-10, 13-10; Common Sense series 60-01, 61-01, 62-01.

Circle 308**M3i Technologies****Booth 418***Existing products*

PCMobile ruggedized mobile computer with optional internal RF modem and antenna for RF communications over public networks; vehicular and portable versions, both compliant with EIA standards for temperature operating range, shock and vibration.

Circle 309**Marconi Instruments****Booth 609***Existing products*

2957 cellular radio test set; 2965 radio test set; 2032 antenna signal processor.

New products

2945 radio test set.

Circle 310**See ad page 51****MaSys****Booth 1004***Existing products*

ENFORS family of public safety integrated software: records, jail, personnel, warrants and civil.

New products

ENFORS/CAD adds capabilities for multi-agency dispatching, unit tracking, agency event

number generation and reporting—enhances system for county or shared system environments.

Circle 311**Maxon America****Booth 403***Existing products*

SP-2000 synthesized handheld with scan—UHF/VHF; SM-4000 synthesized mobile with scan—UHF/VHF; CP-0500 crystallized handheld—UHF/VHF; TP-4800 trunking handheld—800MHz; TR-4800 trunking repeater—800MHz; SP-5050 HD synthesized handheld—25MHz–50MHz.

Circle 312**See ad page 53****Maxrad****Booth 303***Existing products*

Antennas.

Circle 313**See ad page 21****MFS Network Technologies****Booth 844***Existing products*

Designs and builds fully integrated communications networks for government and business—a systems integrator that will manage every required project service, including financing, design, systems integration, project management, construction, maintenance and facilities management.

Circle 314**Midland Land Mobile Radio****Booth 106***Existing products*

Portable radio series; Syn-Tech XTR series of mobile and portable radios; Syn-Tech II series of

mobile radios; Base-Tech series of dispatch and repeater stations.

New products

70-147, 70-148, 70-248 portable radios; 70-1342BMM, 70-1395BMM, 70-1495BMM Multi-Mode mobiles; 70-3340 and 70-3530 Multi-Mode platform radios.

Circle 315**See ad page 35****Mobile Radio Technology****Booth 318***Existing products*

Mobile Radio Technology is recognized as the leading source of technology-focused industry guidance. Readers include mobile radio dealers and service shops, large-volume end-users at public safety, government, transportation, business and industrial agencies, as well as paging and SMR service providers, and manufacturers and their reps and distributors. The editorial addresses the latest in equipment and applications, business developments, legal and regulatory matters. Visit us at our booth to pick up a copy and sign up for your free subscription.

Circle 316**Modular Communication****Booth 506***Systems**Existing products*

Ultracom Pro console system.

Circle 317**See ad page 63****Motorola Land Mobile****Booth 623***Products Sector**Existing products*

We'll show you how to turn information flow into cash flow.

Most Service Information Systems simply process information. ServicePlus, on the other hand, actually puts your business information to work for you—to eliminate late and missed invoicing opportunities, increase technician performance, and optimize inventory movement.

ServicePlus manages the service cycle through a single point of entry (Logbook) to provide your staff with immediate access to accurate data and easy to understand decision support tools. Our system structure ensures that all processes in the cycle are complete and your information retains the highest level of integrity.

Hottest Price/Performance in its class!

\$2780

Buy you a network-capable system including: SP Manager, Logbook, Inventory Control and Service Contracts.

ServicePlus modules include:

- SP Manager
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- Service Contracts
- Dispatch
- Purchase Orders
- ACCPAC Plus™, Great Plains™ or SBT™ Accounting Interface

Information you can trust...Information you can profit from.

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Series | 2

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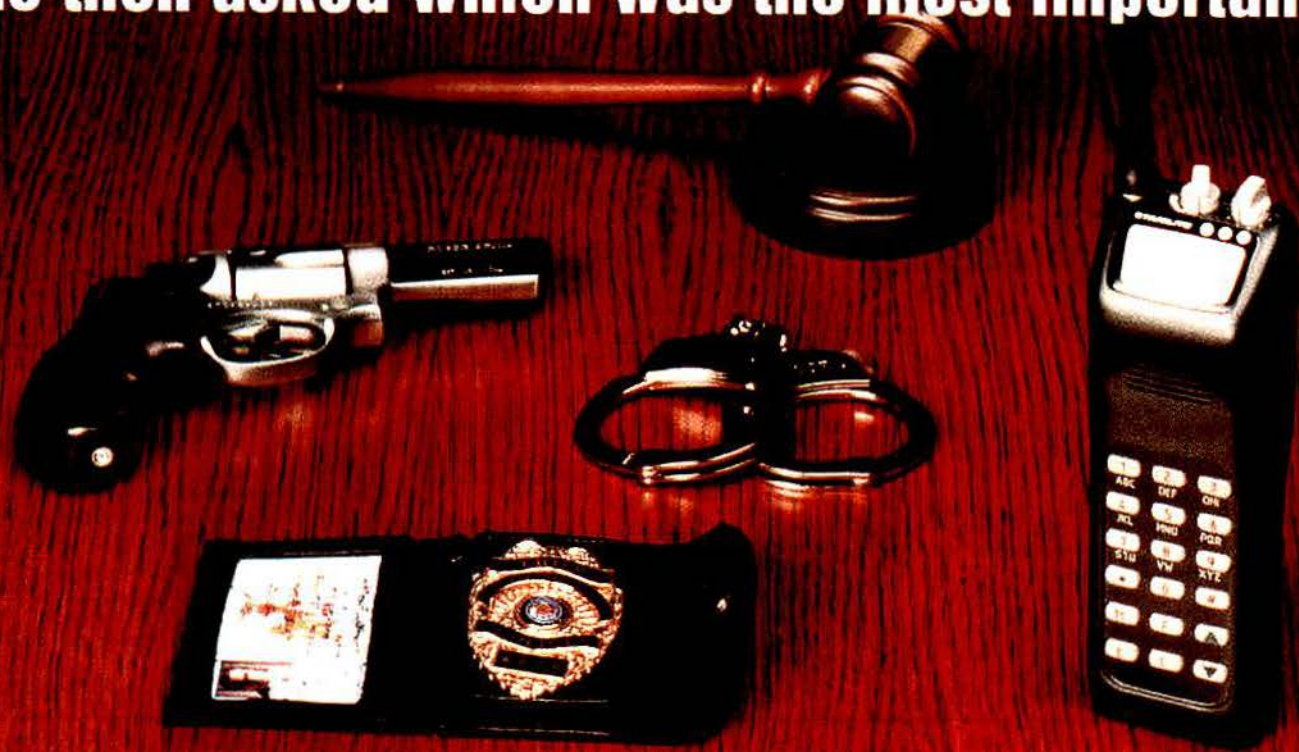
Tel: (613) 521-7391

Fax: (613) 521-5595

Internet:

netlink@service.magi.com

The Chief of Police placed his gun, handcuffs, badge and a radio in front of the City Council. He then asked which was the most important.



The old timers knew the gun wasn't the right answer, but we still enjoyed watching the Chief make his point. After 22 years on the force, you learn a lot of lessons... like the value of teamwork, communications, backup, and support.

"Your radio is the most often used tool you have... and it's the most important" he'd say. "On the other end of your radio is something nobody wants to mess with... and that's every other member of the police department." He made his point.

The Chief is quite a character. He intimidates some. Others just look up to him. Once you get to really know him, you realize deep down, he regards each and every one of us as part of his family.

Perhaps that's why this unique presentation to the budget committee was so persuasive. It was time to upgrade our old radios to the new APCO 25 digital standard. The Chief chose Stanilite. Limited budgets were not going keep his department from having a communications system with all the best features. To this man, nothing was more important than having each of us safe every night.

Stanilite... for those who want all the features without all the costs.



1610 West Street Annapolis, MD 21401 Phone 410-263-2481 Fax 410-263-8760

Circle (49) on Fast Fact Card

Visit us at APCO, Booths 300

Integrated voice and data systems; Astro digital radio communications systems; Smartzone and Omni communications systems; analog radios.

New products

Forte portable data terminals; MCS dualmode (analog and digital) mobile radios.

Circle 318

See ad pages 5, 52

Mounting Solutions

Booth 1234

Existing products

Over-the-hump vehicle mounts for Crown Victorias and Caprices; radio racks; universal laptop mount; sunscreen for laptops and MDTs; pedestal mounts; MDT mounts.

New products

Ruggedized screen holder; light attachment for laptop mount.

Circle 319

NCG Company/

Booth 1126

Comet Antenna

Existing products

Complete line of Comet mobile and fixed station antennas; mobile mounting systems; antenna duplexers; accessories.

New products

Comet FX-555NMO elevated cellular look-alike mobile antenna for transmitting on VHF, UHF and cellular simultaneously.

Circle 320

New World Systems

Booth 503

Existing products

Aegis public safety software, including com-

puter-aided dispatch for law enforcement, fire and EMS; mobile computing technologies; Interface software for state/NCIC, encoders, pagers.

New products

CAD mapping; laptop field reporting; CAD interface; state/NCIC interface.

Circle 321

Northpoint

Booth 1115

Communication Products

Existing products

Complete line of Lo Pro mobile antennas that are 5/8" tall and feature 3dB gain, omnidirectional radiation pattern.

New products

Lo Pro NP 4020 UHF antenna, 410MHz-424MHz; Lo Pro NP 4025 UHF antenna, 416MHz-430MHz; Lo Pro NP 4065 UHF antenna, 457MHz-474MHz; Lo Pro NP 4080 UHF antenna, 470MHz-490MHz.

Circle 322

O A R

Booth 510

Existing products

4000 series DF processors; MA1300 series mobile DF antennas.

New products

4400 DF processor/receiver; MA800 cellular band DF antenna.

Circle 323

OCS Technologies

Booth 1030

Existing products

Computer-aided dispatch; records management

systems for law enforcement, fire and EMS.

New products

Dispatch² computer-aided dispatch.

Circle 324

Orbacom Systems

Booth 1215

Existing products

TDM-150 series distributed microprocessor communication control centers; Calida+ desktop 16-channel user-programmable console; TDM-150 CRT communications control center.

Circle 325

See ad page 79

PacketCluster Systems

Booth 1423

Existing products

Mobile data communications systems for public safety.

New products

Mobile data system with CAD/RMS interface and automatic vehicle location.

Circle 326

PolyPhaser

Booth 1400

Existing products

Grounding systems and lightning arrestors for twisted pair and ac power. Protectors for data, telco, LAN and CCTV available. Custom manufacturing capability and products.

New products

IS-MR50LNZ+6 coaxial protector for global positioning system (GPS) receivers with active antennas.

Circle 327

See ad page 66



Great Caesar's Ghost!

STI-CO's new totally disguised custom fender mount antennas with rugged stainless steel masts offer **super bandwidths** and a built-in ultra high efficiency AM/FM broadcast coupler.

The **XXX-SB-150** Series has **24 MHz bandwidth** (150-174 MHz), and the **XXX-SB-450** Series has **67 MHz bandwidth** (403-470 MHz).

Of course, only STI-CO can provide exact AM/FM antenna replacements for all Chrysler, Ford, GM and many Euro-Asian body styles!

More **supercolossal news** from the...

DISGUISE GUYS



11 COBHAM DR, ORCHARD PARK, NY 14127 (716) 662-2680 FAXES (716) 662-5150, (800) 685-1122

See The Latest Who, What, When, Why, And Where In Communications.

Who delivers digital technology for improved clarity, security, and coverage?

What will help me extend my lifeline to the community and my users?

When will I be able to talk longer and farther than I can now?

Why is having access to multiple vendors important?

(Hint: The **Where** is at Ericsson's booth #1206 at the
61st APCO Conference in Detroit.)

ERICSSON 

Power Conversion Products Booth 319*Existing products*

De power supplies, systems and related equipment, including ac-to-dc rectifiers and dc-to-dc converters using switchmode technology and modular design.

New products

TwinPack Plus modular design dc power supply.

Circle 328

Public Safety Systems (PSSI) Booth 1016*Existing products*

RESPONSE computer-aided dispatch system and associated CAD system interfaces; records management applications.

New products

FIREs newly updated Windows-based fire and EMS incident reporting system.

Circle 329

Racal Recorders Booth 1201*Existing products*

Wordsafe Maxima; Rapidax Ranger DTL.

Circle 330

Redm Communications Booth 412*Existing products*

Two-way crystal and synthesized mobile, portable and base radios; repeaters; base station components and subsystems; multiplexed antenna systems; IM suppression products.

New products

RIBR inband repeater; RCBR crossband repeater.

Circle 331

See ad IBC

RF Industries Booth 1334*Existing products*

RFA-4024 Unadapt kit; RFA-4007 heavy-duty forged crimping tool kit; RFA-4041 Unicable kit; RFA-4027 SMA adapter kit.

New products

RFA-4026 Celludapt kit; RFA-4017 cable testing kit; RFN-1001-S N male universal cable plug; RFA-4089 miniature pin crimping tool.

Circle 332

Rohn Booth 1013*Existing products*

Self-supporting towers; guyed towers; steel poles; concrete poles; fiberglass equipment shelters; concrete equipment shelters.

New products

RT1800 and RT2400 walk-in fiberglass equipment cabinets.

Circle 333

S & R Systems Booth 600*Existing products*

CAD, records management (police and fire); jail management; community care; mobile data (four levels); mapping.

New products

Windows-based products; Auto-Geo base creation; Mobile Session Manager for mobile data.

Circle 334

Sabre Communications Booth 931*Existing products*

Antennas; guyed and self-supporting towers; in-

stallation services; microwave services; mobile towers; mounts/mounting equipment towers; site services; tower lights.

Circle 335

See classified ads

Scala Electronic Booth 1200*Existing products*

Trunking, paging, point-to-point, control station and two-way antennas.

New products

SMT-1000 mobile tester designed to assist in the installation of analog and digital mobiles and portables in the 400MHz-512MHz or the 806MHz-935MHz range.

Circle 336

Shadow Technologies Booth 115*Existing products*

Chameleon frequency-hopping, hand-held radio.

New products

SFH-41 Chameleon frequency-hopping, hand-held radio.

Circle 337

Shinwa Communications of America Booth 509*Existing products*

Checkmate IV tone and voice pagers; STAT series portable and mobile radios; desktop repeater and base station; CAD dispatch system.

New products

Desktop repeater/base station.

Circle 338

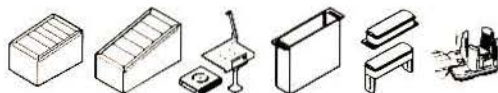
GAMBER-JOHNSON**MCS-100 SERIES**

The Gamber-Johnson MCS-100 Series is an economical alternative to consoles for mounting voice and data communications equipment in your Caprice or Crown Victoria.

Our base is one piece, made of 3/16" electrostatically powdercoated steel. For safety, all edges are milled and corners rounded. Our design allows installation in minutes without drilling or modifying the vehicle. Our radio brackets are universal and simple to install and adjust. The 22 1/2" mounting surface gives you room for up to six sets of radio brackets, or a combination of brackets and a Gamber-Johnson MCS Series MDT or Laptop/Notebook mount. We even offer an adjustable armrest to assure an ergonomically correct work station.

The simplicity and strength of our design provides a margin of safety unsurpassed in the industry, and ease of installation which saves you time and money. Of course, the MCS-100 system is air bag friendly when properly installed, and, if desired, may be upgraded to an enclosed console protecting your initial investment years into the future.

Partial
accessory
sampling

**MCS-100 SERIES**

For information now
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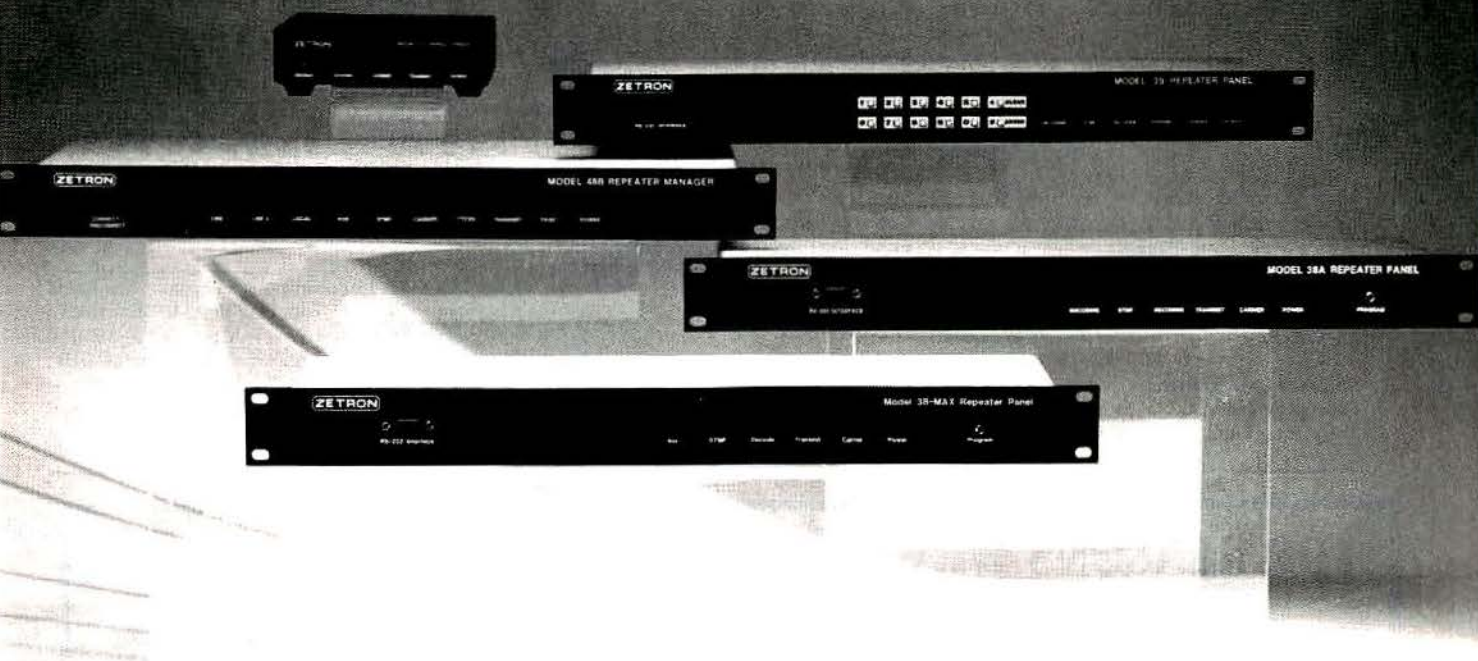
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Circle (53) on Fast Fact Card

Sinclair Technologies Booth 1101
Existing products _____
Base station antennas, filter and combining equipment.
Circle 339 See ad page 70

Slattery Software Booth 947
Existing products _____
FCC licensing software.
New products _____
FCC licensing software for FCC form 600.
Circle 340 See classified ads

SMC Electro-Mount Booth 1300
Existing products _____
S2000 series installation systems; VMS series laptop mounts.
New products _____
S2000 custom consoles; VMS series "sliding" laptop mount; S2000 consoles—accessories, arm rests, 12V outlets.
Circle 341 See ad page 16

Sonic Communications Booth 404
Existing products _____
Two-way radio communications accessories, including headsets, ear mics, throat mics, motorcycle and automobile racing equipment, wireless receivers and various surveillance kits.
Circle 342 See ad page 12

Spillman Data Systems Booth 940
Existing products _____
Fully integrated public safety software for

records management, CAD with Geobase, traffic information, premises information, NIBRS reporting.

New products _____
CAD Response Plan software module provides response plans with responding units and unit types, move ups and covering units, call-back plans, mutual aid and premises information interface.
Circle 343

SPJ Furniture Technology Booth 608
Existing products _____
Hexocom electronically height-adjustable communications workstation.
Circle 344

Stainless Booth 221
Existing products _____
Guyed towers; self-supporting towers; monopoles.
Circle 345

Stancil Booth 703
Existing products _____
Centurion digital voice recorder; SIR Stancil instant recall recorder; DBR VHS format voice recorder.
Circle 346

Stanilite Booth 300
Existing products _____
Cellular switch; conventional repeater.
New products _____

APCO 25 digital base stations, mobiles and infrastructure.
Circle 347 See ad page 57

Stealth Network Technologies Booth 409
Existing products _____
Concealment devices, such as rooftop enclosures, Bell & Clock towers, water tower caps, silos and high-rise road signs.
New products _____
Concealed and non-penetrating rooftop platform along with a mapping system that will show the addresses of high-rise road sign locations in select cities; RF transparent flagpole for PCS omnidirectional antenna concealment.
Circle 348

Sti-Co Industries Booth 500
Existing products _____
Disguised mobile two-way antennas, including custom fender-mount lowband, highband, UHF and cellular/trunking models; cellular look-alike VHF, UHF and dualband antennas; low-profile transit antennas; couplers; tuners; and dual matched systems.
New products _____
XXX-SB-150 stainless-steel custom broadband antennas, VHF, with built-in AM/FM broadcast coupler—150MHz-174MHz; XXX-SB-450 stainless-steel custom broadband antennas, UHF, with built-in AM/FM broadcast coupler—403MHz-470MHz; XXX-S-800 stainless-steel custom broadband antennas, cellular/trunking

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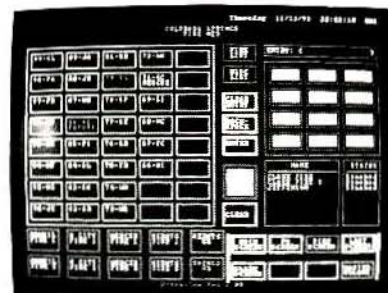
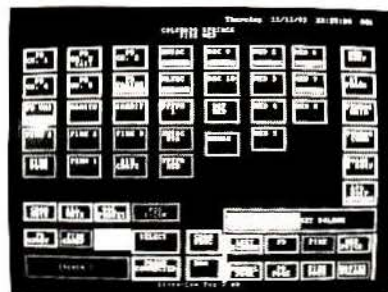
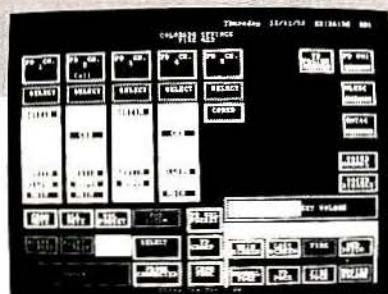
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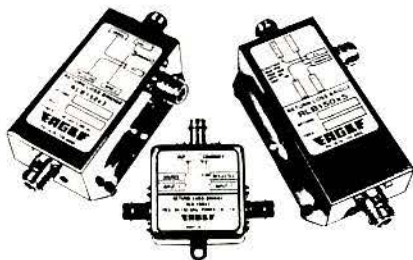
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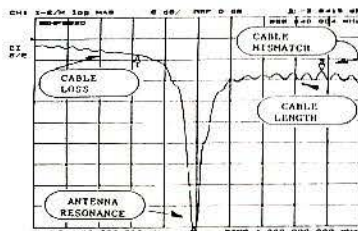
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Circle 349

See ad page 58

TEAC America

Booth 833

Existing products

Digital voice logging equipment and instant recall recorders, including optical disk, 8mm, 4mm, (DAT) and VHS media technologies.

New products

CR-400 DAT recorder; CR-PCR PC remote station; DCR-4000 optical disk system.

Circle 350

Tiburion

Booth 711

Existing products

CAD/2000 computer-aided dispatch; RMS/2000 police and fire records management; mobile data computing.

New products

CAD graphical user interfaces; RMS graphical user interfaces; automated CAD status mapping; MAKO Windows mobile data workstation.

Circle 351

Transcrypt International

Booth 1040

Existing products

Infosec analog encryption (scrambling) modules for land mobile radio and cellular products from four-code to non-linear, none-predictive trillion code modules; cellular voice privacy (CVP); Transpulse mobile computer; status modules and status control products; computer-aided dispatch (T-CAD) software telemetry; signaling products; radio products—repeaters; PX scrambler is embedded in the Motorola MicroTAC cellular phone.

New products

DME 9600 dualmode encryptor provides both digital encryption and analog voice privacy over the public switched telephone network (PSTN); Project 25-upgradable portable two-way radio.

Circle 352

See ad page 3

TRW—Systems Integration Group

Booth 636

Existing products

TRW tone alert receiver; EBS-, NOAA- and CSEPP-compliant; Verafind automated identification system; 3D RF communications design model.

Circle 353

TWR Lighting

Booth 841

Existing products

Red light, white light and dual red and white systems for aviation obstruction applications.

New products

Low voltage strobe light systems.

Circle 354

TX RX Systems

Booth 630

Existing products

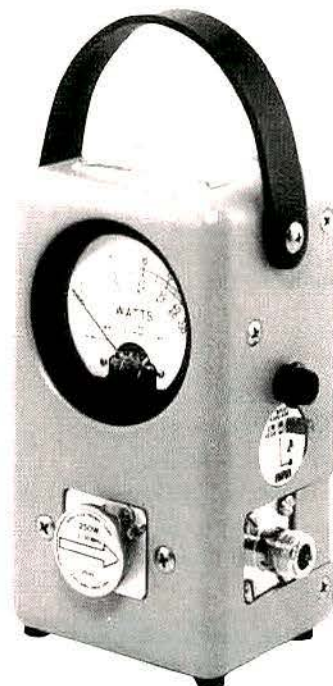
Multicouplers; signal boosters; duplexers; filters; RF system products.

Circle 355

See ad page 11

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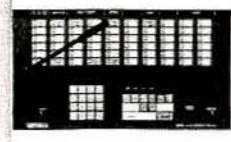
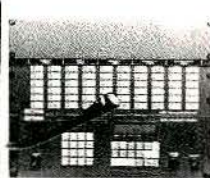
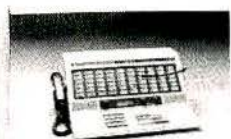
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New products _____
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Circle 356

Unisys **Booth 633**
Existing products _____
LifeLine computer-aided dispatch solution; SunPro fire records management solution; EIS international emergency management solution; Concorde Key Systems computer-aided resource management.
New products _____
Lifeline Records 2000.
Circle 357

Valmont Industries **Booth 613**
Existing products _____
Design and manufacture tapered, tubular steel monopoles; guyed towers; self-supporting lattice towers; ancillary equipment and installation services for the communications industry; camouflaged monopoles for edge in restrictive zoning areas.
New products _____
Redesigned lattice tower line; camouflaged monopoles.
Circle 358

Valor Systems **Booth 819**
Existing products _____
Windows-based computer-aided dispatch system.
Circle 359

Vega, a Mark IV company **Booth 1000**
Existing products _____
5200 control console; C510-C, C-516, C1614R control console.
New products _____
1505 audio mixer/line driver; 1690 audio processor module; 1756 octal relay module.
Circle 360 **See ad page 1**

Watson Furniture Systems **Booth 420**
Existing products _____
Ergonomic and acoustic console furniture for desktop and rack-mount applications.
New products _____
Basik 5 power primary 90°; Basik 2 power primary 90°.
Circle 361

Westinghouse Electric **Booth 1232**
New products _____
Series 1000 mobile satellite telephone system; vehicle emergency messaging system.
Circle 362

Winnebago Industries **Booth 236**
Existing products _____
Winnebago commercial vehicles.
New products _____
Rialto shell.
Circle 363

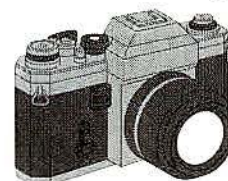
WirelessWorld magazine **Booth 318**
Existing products _____

Published bi-monthly, *WirelessWorld* provides market updates, engineering information, applications stories and the latest news of the broadband and narrowband PCS and paging industries. Readers include PCS licensees and applicants, operators of paging, cellular and E-SMR systems, as well as CATV system operators, inter- and local-exchange carriers and large-volume end-users, manufacturers and their reps and distributors. The 1995 WirelessWorld Expo will be held in San Francisco Nov. 7-9. Call 800-458-0479 to attend.

Circle 364

Zetron **Booth 706**
Existing products _____
Radio communications control equipment, including radio console systems, PSAP telephone system, modular dispatch and PSAP accessories, headset interface, fire station alerting system, message recorders.
New products _____
3100 PSAP telephone system.
Circle 365 **See ad pages 22, 61, 65**

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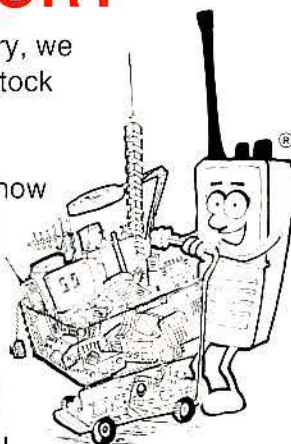
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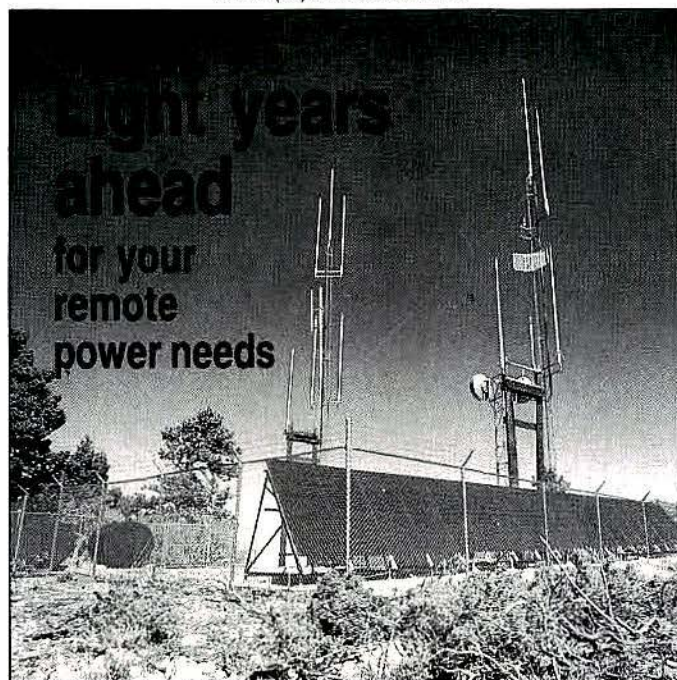
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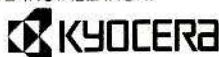
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Technically speaking

(continued from page 8)

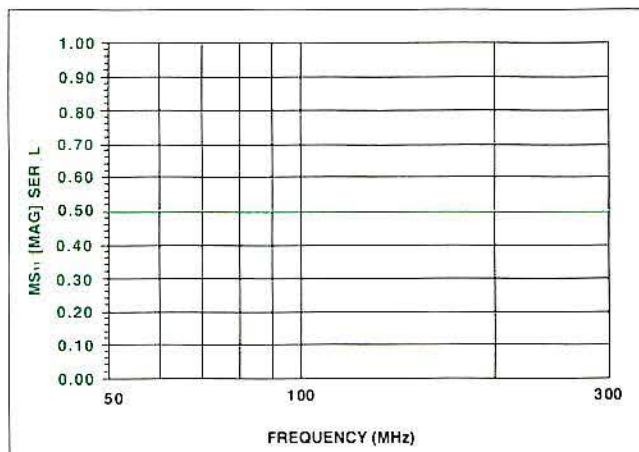


Figure 3. The circuit shown in Figure 2 (100Ω resistor) produces the S_{11} -parameter of 0.5 as shown in this graph. Since the network is purely resistive, the S_{11} -parameter remains constant with changes in frequency. The parameters S_{12} , S_{21} and S_{22} are also equal to 0.5 and remain constant with changes in frequency. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

The return loss is $20\log 1/0.5 = 20\log 0.5 = -6.02\text{dB}$. Figure 3 above is a graph of the magnitude vs. the frequency of S_{11} of the 100Ω resistor. Because the network is purely resistive, the magnitude of S_{11} is the same at all frequencies.

Calculating S_{21}

Because this network is purely resistive, the phase angle at the input port (S_{11}) is going to be 0° . Because the incident signal at the input port is normalized to 1, the reflected signal is 0.5, for a reflection coefficient of 0.5. Because the phase angle is 0° , the reflected voltage wave combines in phase with the incident voltage wave and therefore adds directly. This combination yields a normalized input voltage of 1.5 at port 1.

Now, consider the 100Ω resistor and the 50Ω termination resistor to be a simple voltage divider. At port 2, the voltage will be one-third (50/150) the input voltage at port 1. The ratio $1.5/3 = 0.5$. The ratio of this voltage to the incident voltage applied to port 1 is $0.5/1 = 0.5$, or -6.02dB . Thus, S_{21} is equal to 0.5 or -6.02dB . A graph of the magnitude of S_{21} vs. frequency would be identical to Figure 3.

Measuring S_{12}

To measure the reverse-transfer S_{12} -parameter, the termination and generator are reversed as shown in Figure 2B. Now the generator output is applied to port 2, and the termination is applied to port 1. Because the 100Ω resistor network is the same looking in from either port, the measurements will come out the same for S_{12} (reverse-transfer) or S_{22} (reverse-reflected). All S -parameters will be equal to 0.5, or -6.02dB . The graph of S_{22} vs. frequency would be identical to Figure 3.

Series LC circuit

Figure 4 below shows a two-port device that consists

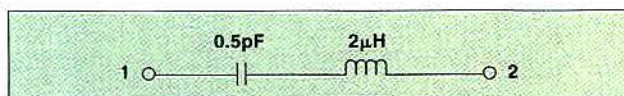


Figure 4. The S -parameters of this series LC circuit are frequency-dependent.

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Technically speaking

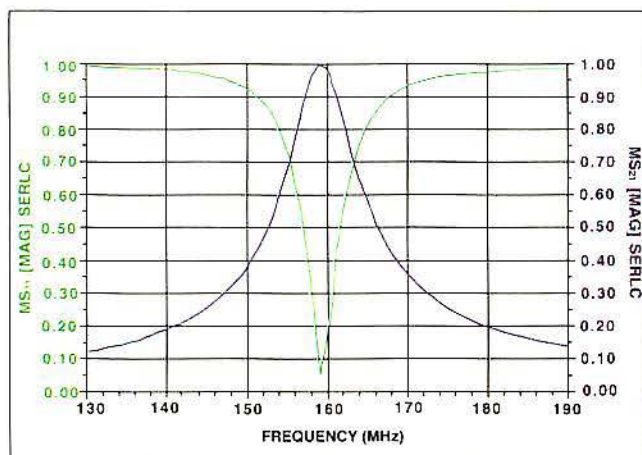


Figure 5. The S -parameters, S_{11} and S_{21} , for the LC circuit shown in Figure 4 are graphed here. Notice that at resonance, about 159MHz, the forward transfer or gain, S_{21} , is at maximum, while the forward reflected or reflection coefficient, S_{11} , is at a minimum. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

of a 0.5pF capacitor in series with a 2 μ H inductor. This series LC circuit's resonant frequency is slightly higher than 159MHz. Figure 5 above shows a graph of the magnitude of S_{11} - and S_{21} -parameters (MS_{11} and MS_{21}) vs. frequency. Notice that at the resonant frequency the forward-reflected S_{11} -parameter is at a minimum and the forward-transfer S_{21} -parameter is at a maximum.

At the resonant frequency, the reflection coefficient magnitude is about 0.05. This coefficient equates to a return loss of $20\log(0.05) = -26\text{dB}$. So, at the resonant frequency, minimal signal reflects back from the input port to the generator.

Also, at the resonant frequency, the forward-transfer S_{21} -parameter is equal to about 1.0. Thus, the loss from port 1 to port 2 is $20\log(1) = 0\text{dB}$ at the series LC circuit's resonant frequency.

Series LCR circuit

Figure 6 below represents a two-port series LCR circuit. The inductance and capacitance values are the same as for Figure 4, so the resonant frequency will be the same—slightly higher than 159MHz. Figure 7 on page 71 is a graph of the magnitude of S_{11} and S_{21} vs. frequency. Note that at the point of resonance the magnitude of S_{11} drops to a minimum of 0.5, and S_{21} rises to a maximum of 0.5.

At the point of resonance, the inductor and capacitor are effectively out of the circuit, and the 100 Ω resistor remains. Thus, the S_{11} - and S_{21} -parameters (at the point of resonance) are the same as the S_{11} - and S_{21} -parameters for Figure 2.

RF amplifier

Figure 8 on page 71 is a two-port device. The device is a wideband RF amplifier, model VNA-25 from Mini-Circuits. A partial list of the S -parameters as taken from the manufacturer's data book are shown in Table 1 on page 71.

A graph of the S_{11} - and S_{21} -parameters for this amplifier is shown in Figure 9 on page 71. Let's suppose that we

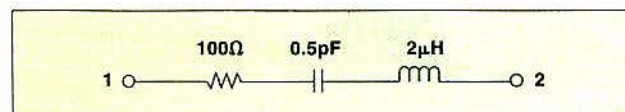


Figure 6. Here an LCR network comprises a two-port device.

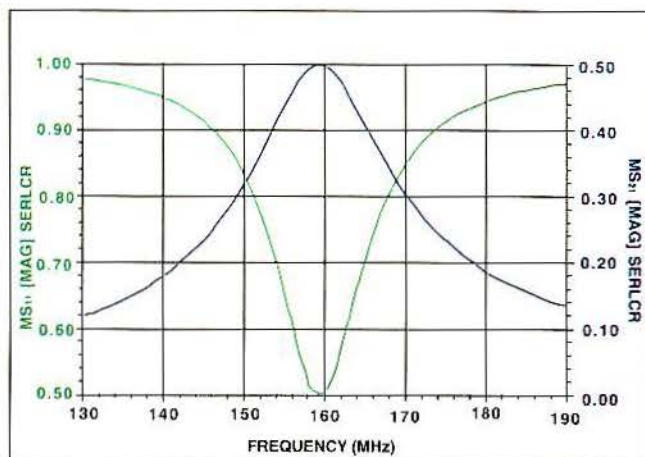


Figure 7. These graphs represent the parameters S_{11} and S_{21} for the LCR circuit shown in Figure 6. See text for details. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

desire to operate the amplifier at about 600MHz, and that we would like to optimize the amplifier performance at this frequency.

Notice that in Figure 9 the S -parameters are given in decibels instead of as a simple multiplication factor. Notice that at about 600MHz the return loss (S_{11}) is about -3.8dB . This loss is equivalent to a VSWR of about 4.7:1. This loss represents quite a poor match at the input for a 50Ω system. We can improve the amplifier's performance merely by adding a simple impedance-matching network at the input port.

A graph of the real and imaginary parts of the amplifier input impedance is shown in Figure 10 to the right. Notice that at 600MHz the real part (resistance) of the impedance is 15Ω , whereas the imaginary part (reactance) of the impedance is -25.5Ω . Thus, the complex impedance at the input port (1) is $15 - j25.5\Omega$.

To achieve an impedance match at 600MHz, a simple LC matching network was placed before the amplifier input. (See Figure 11 on page 72.) With this LC impedance-matching network in place, the graph was plotted again, as shown in Figure 12 on page 72. Notice that at 600MHz the real part of the impedance is 50Ω , and the imaginary part of the impedance is 0. Thus, at 600MHz the input impedance is a pure resistance of 50Ω .

The S -parameters, with the LC matching network in place, are shown again in Figure 13 on page 72. Note that at 600MHz the return loss at the input port is -19dB , or a VSWR of about 1.25:1. Without the matching network, you will recall, the input VSWR was about 4.7:1.

Notice, too, that at the resonant frequency the gain (S_{21}) has

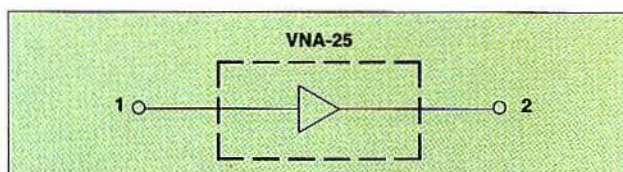


Figure 8. This wideband RF amplifier, the model VNA-25 from Mini-Circuits, can be fully analyzed with S -parameters. Table 1 is a partial list of the S -parameters in the manufacturer's specifications.

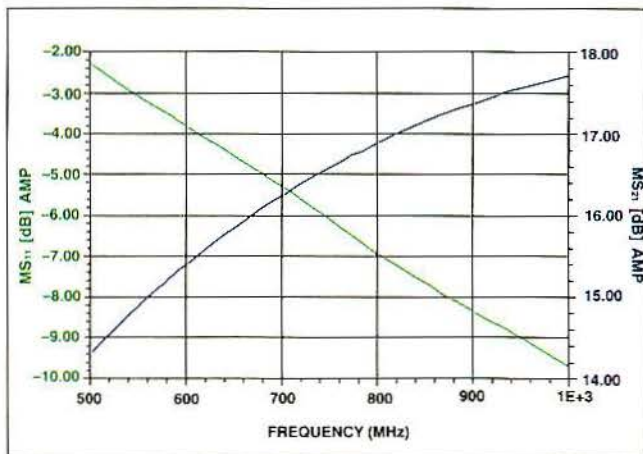


Figure 9. The parameters S_{11} and S_{21} , for the amplifier shown in Figure 8, are graphed over the frequency range of 500MHz–1,000MHz. The magnitudes are given here in decibels. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

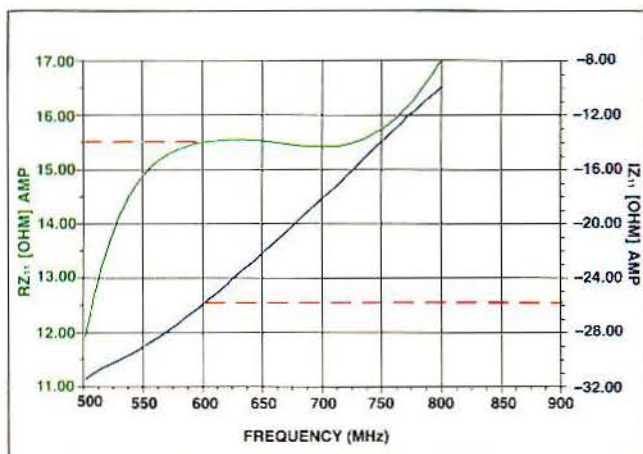


Figure 10. This graph of the input impedance (real and imaginary parts) of the amplifier shown in Figure 8 reveals that the input impedance at 600MHz is about $15.5 - j25.5\Omega$. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

Table 1. A partial list of the S -parameters from the manufacturer's data book on the wideband RF amplifier shown in Figure 8.

F (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		K
	Magnitude	Angle	Magnitude	Angle	Magnitude	Angle	Magnitude	Angle	
500	0.769	-110	5.2	22	0.012	83	0.157	12	3.34
600	0.644	-127	5.9	-15	0.010	17	0.159	-44	4.97
700	0.543	-144	6.5	-48	0.011	-17	0.185	-77	4.89
800	0.450	-159	7.0	-78	0.010	-38	0.206	-103	5.57
900	0.382	-172	7.4	-106	0.010	-56	0.216	-126	5.60
1,000	0.326	92	7.7	-132	0.010	-72	0.219	-150	5.62

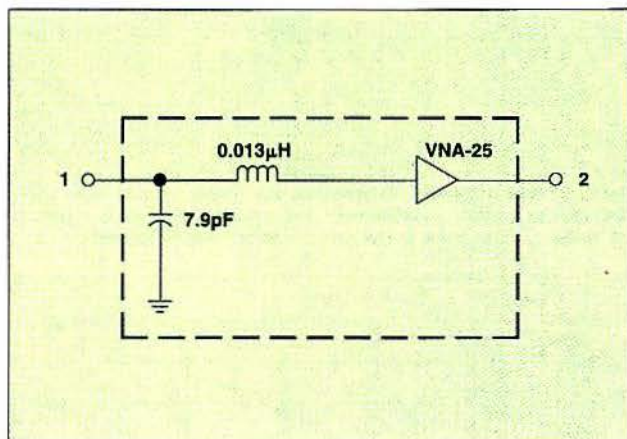


Figure 11. In order to achieve a better impedance match at 600MHz, a simple LC matching network was added to the input of the amplifier shown in Figure 8.

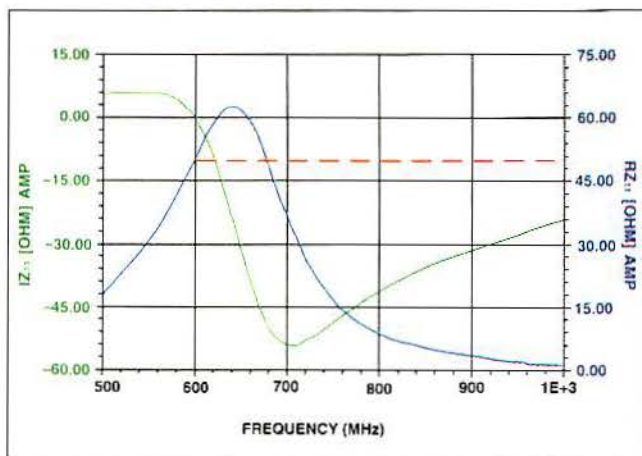


Figure 12. This is a graph of the input impedance of the circuit shown in Figure 11. Both the real and the imaginary parts of the impedance are graphed. Notice that at 600MHz the real part of the impedance is 50Ω, while the imaginary part of the input impedance is 0Ω. Thus, the input impedance at 600MHz is a pure resistance of 50Ω. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

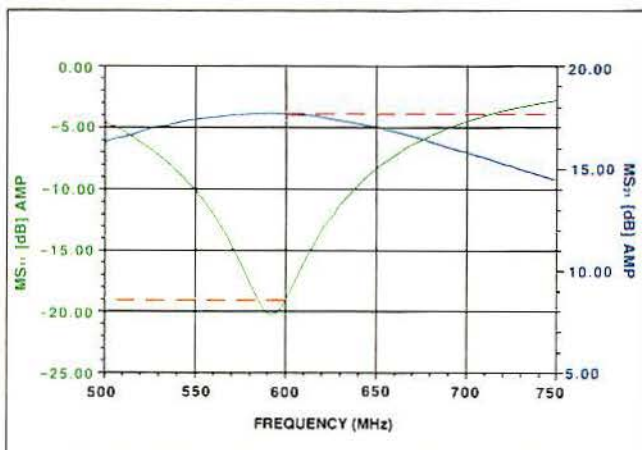


Figure 13. The S_{11} and S_{21} for the circuit shown in Figure 11 are graphed here. The gain, S_{21} , at 600MHz is about 17.7dB, while the return loss, S_{11} , at 600MHz is about -19dB. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

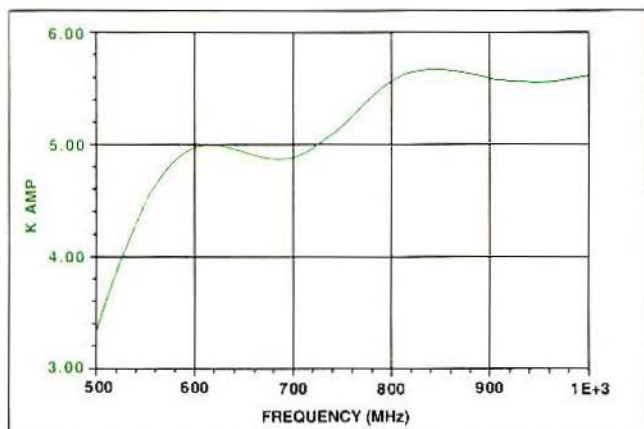


Figure 14. The K -factor of the circuit shown in Figure 11 is graphed here. As long as the K -factor is above 1, the amplifier is considered very stable under all load conditions. Notice that at 600MHz the K -factor is nearly 5, indicating high stability. This graph was produced with Compact Software's *ARRL Radio Designer 1.0*.

increased from 15.4dB to about 17.7dB—an increase of 2.3dB, representing a 70% increase in power gain.

K-factor

Another important parameter that should be mentioned is the K -factor. This factor provides an indicator of an amplifier's stability. Generally, a K -factor less than 1 indicates that an amplifier may not be stable under all load conditions. A K -factor greater than 1 indicates that the amplifier is stable. The higher the K -factor (greater than 1), the better the stability.

Figure 14 above is a graph of the K -factor of the amplifier circuit shown in Figure 11. Because the K -factor is considerably greater than 1, the amplifier is considered to be unconditionally stable. At 600MHz, the K -factor is almost 5. The amplifier should be stable for all load conditions at this frequency.

Phase parameters

As mentioned earlier, S -parameters have both magnitude and phase. Figure 15A below shows a two-port network consisting

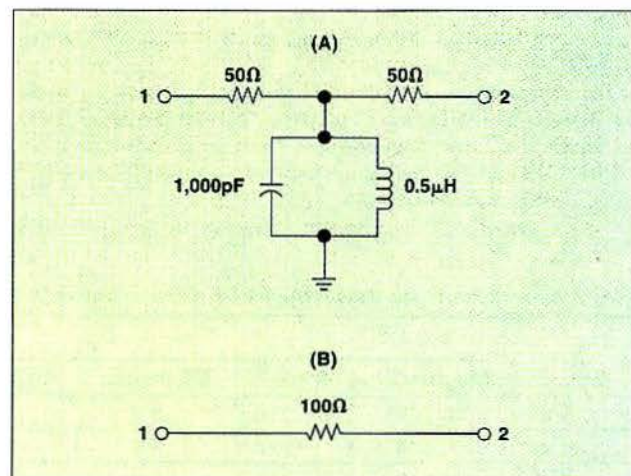


Figure 15. Figure 15A shows a parallel LC resonant circuit connected between two 50Ω resistors and ground. At resonance, about 7.12MHz, the parallel resonant circuit will be effectively removed from the circuit, leaving only the two 50Ω resistors. Then, the two 50Ω resistors can be simplified into a single 100Ω resistor as shown in Figure 15B.

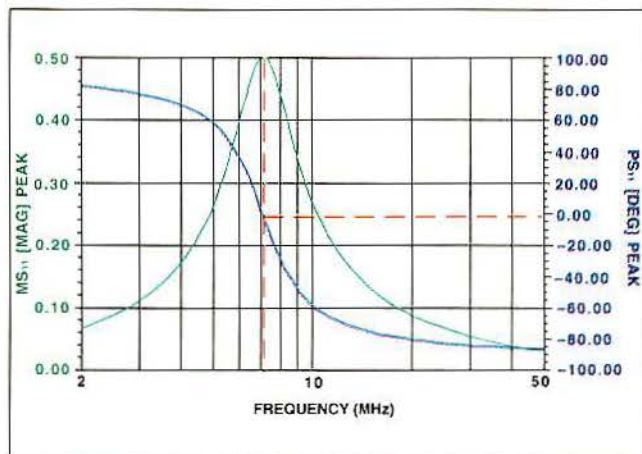


Figure 16. This is a graph of the magnitude and phase of the parameter S_{11} for the circuit shown in Figure 15A. At resonance, the phase angle is 0° . The magnitude of S_{11} is the same at resonance as for the 100Ω resistor shown in Figure 2. This graph was produced with Compact Software's ARRL Radio Designer 1.0.

of two 50Ω resistors and a parallel LC circuit tuned to about 7.12MHz. At the point of resonance, the parallel LC resonant circuit exhibits such high impedance that it can be effectively eliminated from the circuit. Two series-connected 50Ω resistors remain that can be further reduced to the circuit shown in Figure 15B.

Figure 16 above is a graph of the magnitude and phase of S_{11} for the circuit in Figure 15A over a frequency range of 2MHz–50MHz. At the point of resonance, 7.12MHz, the phase of S_{11} passes through 0° . Thus, at this frequency, the circuit is purely resistive.

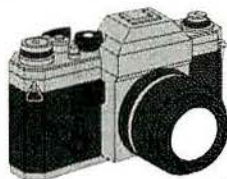
Summary

As you can see, the S-parameters provide a useful means for analyzing two-port networks. It is not necessary to know the exact component makeup of the two-port device. If we study the complete set of S-parameters (along with the K-factor), we can effectively analyze the operation of the circuit over the desired frequency range.

'Til next time... stay tuned!



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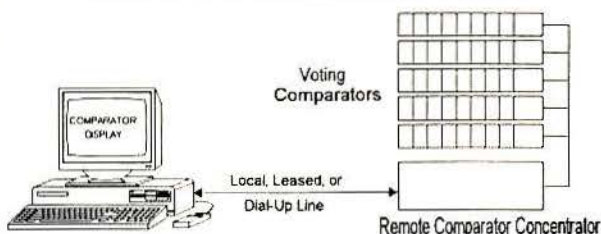
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In search of the public interest

By Robert H. Schwaninger, Jr.

If you've grown tired of the "O.J. Trial" and are looking for headier stuff, try the Senate hearings on Senate Bill S652, the newest proposed revision in the Communications Act. If the Senate exercises its normally slow pace in debating the issues of the day, the hearings should still be going on when this column is published. But just in case our elected officials have wrapped up the matter, here's some of what you missed.

The week of June 4 the Senate discussed whether the FCC should decide what the public interest is, or whether Congress should tell the FCC what it is and then make sure that whatever Congress says it is, the FCC doesn't come up with some other wacky idea. This amazing discussion arose out of a proposed amendment put

forth by Senator McCain of Arizona who said that the public interest is an ill-defined concept, subject to different in-

terpretations. (You don't say, senator?)

Senator McCain did not believe that this nebulous concept should prevent Regional Bell Operating Companies (RBOCs) from competing in the provision of cable, video-on-demand, messaging service and wherever else the telecommunications behemoths might cast an eye. In other words, the good senator didn't want the FCC deciding that the public interest might not be served by allowing RBOCs to provide cable television in every market.

Each of the senators who spoke admitted that the FCC's use of a public interest standard has, in effect, created the ability to interject politics into every decision, and Senator Craig of Idaho went so far as to state that the public interest standard is recreated each time the FCC employs its own interpretation on a case-by-case basis.

The content of these comments



Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

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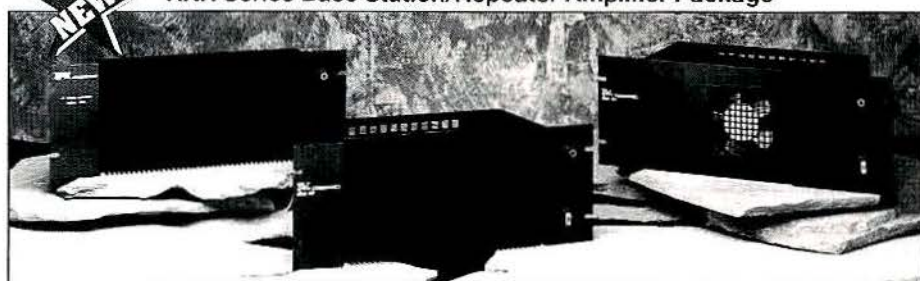


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by the senators are hardly revelations. They aren't even news to the thousands of radio operators. The industry and the FCC and Congress have been wrangling for years over what is *the public interest*.

In the words of Justice Potter Stewart when asked to define pornography, "I can't define it, but I know it when I see it." More importantly, I know what it isn't.

The public interest isn't any of the following:

- It isn't the use of U.S. tax dollars to explore the commercial viability of new technology, to produce research and development to the benefit of only the largest entities, e.g., high-definition television.

- It isn't forced frequency migration to make room for a service for which no demand has been demonstrated by the public, to the detriment of small business and for the benefit of a single operator, e.g. the pending 800MHz SMR rulemaking.

- It isn't spectrum give-aways to the richest operators, high-priced technology requirements for small business, increased bars to market-entry for small business, application mills, favoritism in application prosecution based on the size of the applicant, refusals to enforce plain rules, spectrum/commodity trading, six more hearings on Children's Television, administrative efficiency, auction money, monopolization and privatization without oversight to prevent abuse, or regulation without due process of law.

When Joe or Fred or Martha has to pay too much for service because the service provider is gathering bucks for the next generation of technology, that's not in the public interest. When the FCC creates monopolies, then fails to make sure those companies don't abuse the privilege, that's not in the public interest. When a telemarketing firm can abuse your home phone to bilk you into agreeing to buy something, that's wrong.

So what is it? The public has an interest in receiving good service at truly competitive prices. Availability and affordability. Simple isn't it? Upon this we all should be able to agree. The disagreements only begin when competing entities begin debating what should be available, at what price and delivered by whom.

Perhaps the biggest problem that has arisen lately in the debate is the existence of those pesky small operators that are incumbent licensees on spectrum now coveted by large corporations. In the rush to consolidate, large corporations have asked the FCC to summarily remove these distractions from the spectrum and place them elsewhere, on some other channels. They argue that the service they will provide is

so new, exciting and valuable that it justifies a telecommunications Trail of Tears.

This new wrinkle in the debate over where the public interest lies (and it does, often) strikes at the heart of the most often forgotten element of the public interest—

... large corporations ... argue that the service they will provide is so new, exciting and valuable that it justifies a telecommunications Trail of Tears.

fundamental fairness. Is it fair to force a legitimate operator off spectrum without total compensation or relief? Is it fair to favor one operator over another based solely on financial status? Is it correct to levy fines based on radio service, rather

than the type of injury caused? Should the FCC ever inject its own agenda into the process in such a manner that its administrative needs are given a greater priority than the public's desire for efficient service? Must all regulation promote the newest technology, or is there something to be said for what's already available?

Perhaps I'm asking too much. After all, the Senate defeated the effort to curtail the FCC's use of its time-honored, vague public interest standard in determining the future rights of RBOCs. And if the likes of Senators McCain, Packwood, Craig, Burns, Hatch, Abraham and Graham can't obtain a more precise definition, what chance do I have?

But you shouldn't be discouraged. Senators stop trying after the votes are counted. It's a whirl, a bang and then silence. Those of us who must live with the consequences of the public interest standard must continue to assist the FCC in seeing that it doesn't fall prey to administrative myopia. So, if you think the FCC has forgotten the meaning of "the public interest," don't hesitate to remind the commissioners. Just don't wait for them to thank you for it.



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Uniden changes 220MHz product marketing strategy

Citing under-capitalization of the 220MHz market, Uniden America, Ft. Worth, TX, has decided to change its 220MHz product marketing strategy. It will focus its marketing efforts on supplying backbone equipment to those license holders whose primary business goal is to meet construction requirements in order to protect the long-term value of their licenses.

Scott Henderson, vice president of the

Commercial Communications Division, said that in the short term, "the 220MHz marketplace does not have the necessary capital available (other than vendor financing) to create an economically viable market for a large-volume manufacturer." He said that Uniden will continue to develop its 220MHz product line and networking software and expects to supply products in the future as the market matures.

Glenayre to provide network equipment for SourceOne Wireless

Glenayre Technologies, Charlotte, NC, has been selected as the network equipment supplier by SourceOne Wireless, Chicago, which is building a nationwide, 900MHz paging system.

The company will use Glenayre's paging switches, transmitters, transmitter control systems and satellite receivers. To date, SourceOne has purchased more than 300 Glenayre transmitters, 300 satellite receivers, two paging switches and a transmitter control system. It plans to purchase an additional two switches in 1995.

Maxon selected as manufacturer of Mobitex OEM modem

Maxon America, Kansas City, MO, has been selected to be the U.S. manufacturer of a new, low-cost wireless OEM modem for integration into various application-specific devices.

Mobitex technology is the de facto standard for two-way wireless data communications and is currently deployed in 14 countries worldwide. Maxon's modems will operate on New York-based RAM Mobile Data's nationwide Mobitex networks in the United States.

Hutton consolidates warehouses

Hutton Communications, Dallas, announced that two more of its warehouses will now be operating under the Hutton name. The warehouse in Atlanta has always used the Hutton name, but now the Denver and Seattle companies, formerly known as Communications Works, will come under the Hutton banner and logo. Bill Mueller, president of Hutton, said that this consolidation will improve the same-day shipping efforts.

Celwave to offer five-year warranty for base antennas

Celwave, Marlboro, NJ, has extended its warranty on all base antennas from one year to five years. The features of the warranty include:

► *Convenient and timely repair and replacement*—Customers can contact the selling dealer, distributor or radio manufacturer for warranty handling.

► *No additional cost*—Whether it is replace or repaired, there is no fee for a returned defective antenna.

► *No sign up or registration*—The base antenna is automatically covered at the time of purchase.

► *Manufacturer's date*—The warranty covers all antennas manufactured after Jan. 1, 1994.



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Readers' choice

Of all the new products and services in the January 1995 issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Transceivers allow functions to be accessed from switches

Two commercial hand-held transceivers from **Icom America** allow as many as 10 programmable functions to be accessed from the front or top panel switches. The IC-F10 VHF model covers frequencies from 136MHz-150MHz or 146MHz-174MHz. The UHF version, the IC-F20, covers 400MHz-430MHz, 440MHz-470MHz or 490MHz-520MHz. Both units have eight-character, alphanumeric LCDs for displaying channel and function information. The 24-channel hand-helds offer two selectable scan lists with three types of scans. Signaling systems include CTCSS standard, with DTCSS, two-tone and five-tone capabilities optional. Automatic ID transmission is also available as an option.

Circle (500) on Fast Fact Card

Programmable 10-channel radio includes adapter/trickle charger

Tekk's T-80 hand-held is a 5W, 10-channel, synthesized wideband radio with channel separation across the entire 150MHz-172MHz bandwidth. Features include programmable scan, priority scan, CTCSS/DCS, internal vox and four battery-save settings. The standard battery is a 1,200mAh NiCd, and a wall adapter/trickle charger is included. The T-80 is PC-programmable for all frequency, scan and signaling features on a per-channel basis.

Circle (501) on Fast Fact Card



Antenna signal processor protects receivers from interference, noise



The model CMA-2032 antenna signal processor from **Marconi Instruments**

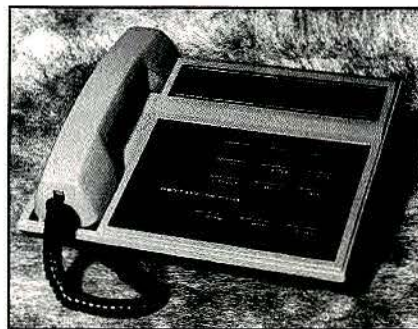
protects base station receivers from co-channel, adjacent channel and broadband interference. It is also designed to eliminate transmitter sideband noise at a co-located receiver site. Configurations are available for mobile, trunking, paging and cellular applications. Connected between the base station antenna and the receiver, the processor can be used to protect individual receivers or a receiver bank of as many as 120 channels. The unit is fully programmable through a serial data interface that also can be used for remote control by modem.

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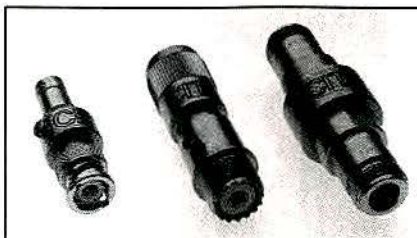
'Smart' remotes and panels allow operator complete base station control

The Super 99 series from **IDA** matches programmable tone remote controllers with a tone termination panel. The Super 99 allows selection of as many as 99 channels or 99 systems/groups and displays the selection in large LED numerals. The microprocessor-based "smart" remotes and "smart" panels allow the operator complete base station control. Standard features include field programmability, intercom, mute, scan on/scan off, clock and VU meter, compression and alert tone.

Circle (402) on Fast Fact Card



Surge protectors absorb multiple surges, automatically reset after strike



Citel America is offering surge protectors for satellite, microwave and radio

applications. A patented coaxial gas tube makes the connectors capable of absorbing many surges without degrading. The protectors shunt to ground all excess electricity and automatically reset after every strike. Protectors are available for UHF, BNC, F and N type connections. They are designed to maintain excellent transmission characteristics to 2.5GHz. In addition, the protectors provide EMI/RFI protection through their shield.

Circle (403) on Fast Fact Card

Portable frequency monitor scans, records radio transmissions on-site

The ScanMan Professional from **CompuSpeak** is a frequency-monitoring device that scans and records radio transmissions on-site. The self-contained unit is fully self-monitoring and offers a computer interface option. Specific frequencies or blocks of frequencies in various ranges from 72MHz to 928MHz can be programmed for scanning. Accumulated data includes frequencies, signal strength and number of occurrences. The information can be viewed on the ScanMan's LCD screen or downloaded through a Windows-based interface to a PC.



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New products

Connectors eliminate need for special trim, flaring

Two female connectors from Andrew are designed for use with the company's foam dielectric transmission line cables. The Type N connector L7PNF is used with 1 5/8"-diameter LDF7-50A cable. The 7/16 DIN connector L12PDF (shown at the right) is used with 2 1/4"-diameter LDF12-50 cable. Both connectors use a patented press-fit design that requires only one flush cut to the cable, eliminating special trim and tab-flaring operations for connection. The L7PNF has a one-piece stub that connects to the inner conductor, replacing the need for a two-piece stub. The L12PDF creates high radial contact pressure, reducing intermod problems. The connector has a peak power rating of 40kW and an average power rating of 3kW at 900MHz.



Circle (405) on Fast Fact Card

Universal computer mount secures in-vehicle laptops

Mounting Solutions has added a universal laptop/notebook mount and laptop/notebook accessories to its line of mobile work force products. Installation and removal of a laptop/notebook computer is accomplished by the turn of a knob. The mount attaches to any of the company's vehicle mounting platforms.

Circle (406) on Fast Fact Card

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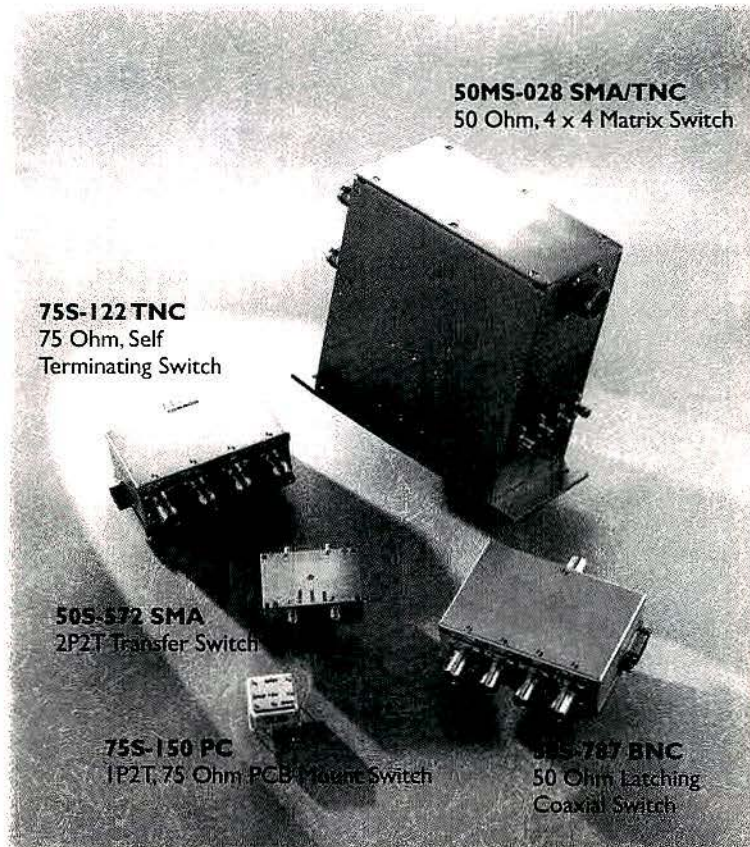
For more information or for a free catalog, contact:

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Circle (70) on Fast Fact Card



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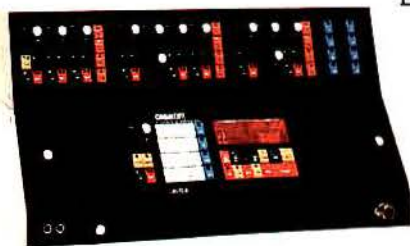
Count on the reliability and performance of communications consoles from Orbakom

In an emergency, reliable communications are the lifeline for survival. That's why so many communications systems rely on Orbakom's CALIDA and TDM-150 consoles. Their superior performance and solid dependability have been proven in the most demanding applications.

If you need the control flexibility of a big console on a small budget, CALIDA is for you. CALIDA handles 16 channels, includes a multi-format paging and signalling encoder, is completely user programmable, and features a 12/24 hour clock, VU meter, alert tone, crosspatch, service intercom, desk mic with PTT and monitor switches, surge protection, and a wealth of other professional features.

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division multiplex (TDM) digital audio processing and complete microprocessor control. Operation is simple and menu-driven. Reliability is ensured through surge protection, self-healing diagnostics, and battery backup. Eight levels of multi-channel radio and telephone patch may be run simultaneously, and an internal paging signalling encoder generates any sequence you'll ever need. Plus the best two-year console warranty in the business.



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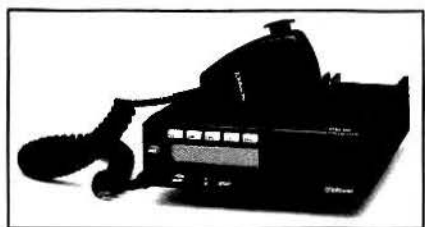


**ORBAKOM
 SYSTEMS, INC.**

Circle (71) on Fast Fact Card

New products

Updated 220MHz trunked mobile displays group IDs, status information



A Phase II model of the Viking LR 220MHz trunked mobile radio has been introduced by **E.F. Johnson**. The Viking LR now features the same control panel and user interface as the Viking GT/HT mobiles. A backlit LCD shows group and unique IDs as well as status information.

Software enables mobile radio to operate with MTS format

Pacific Circuit Design has engineered software for Tait Electronics to allow the Tait T2020 mobile radio to operate with the MTS format. The software allows normal operation of the radio plus functionality for use on the Mobile Telephone Service Network.

Circle (408) on Fast Fact Card

Knob controls and function buttons, including an emergency call button, access radio features and menu options. A 3W speaker is located on the front panel. The 220MHz linear modulation technology includes a high-speed data capability as fast as 9,600bps. A telephone interconnect feature allows use of as many as 99 prestored telephone numbers. A DTMF microphone is available as an option.

Circle (407) on Fast Fact Card

Radio remote for Kenwood radios puts control at the base station

Zetron's model 230A radio remote controls Kenwood TK 930, 930 HD and TK 931 radios at the base station. The remote provides complete control over all radio functions and can operate over any voice-grade circuit. Features include an LCD for system or group numbers and user-created group labels. Private communications are possible between dispatch and specified mobiles or between model 230A remotes. A DTMF keypad is available as an option for selective signaling.

Circle (409) on Fast Fact Card

Power system allows replacement of modules without shutting down



The HS Power System from **Newmar** provides 24Vdc or 48Vdc from a 230Vac source in a fully redundant configuration. Designed for microwave, cellular and telecom sites, the fault-tolerant system allows for failure in one power module without interrupting system operation. A "hot swap" feature allows the removal and replacement of individual modules without shutting down the system. The system consists of a power shelf, rated at 8,100W, that mounts into a standard 19" rack and accommodates three separate 24Vdc or 48Vdc power modules (sold separately) that are rated at 2,700W each.

Circle (410) on Fast Fact Card

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Circle (72) on Fast Fact Card

Log periodic antenna offers 40dB front-to-back ratio, two beamwidths

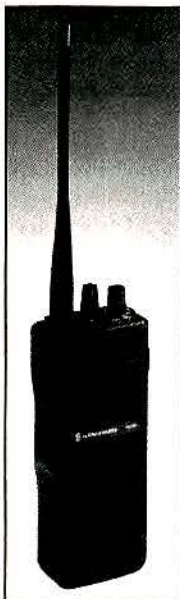
The dB Director from the **Decibel Products** division of Allen Telecom Group is a log periodic antenna for use in the 806MHz-960MHz range. The antenna reduces potential co-channel interference with a front-to-back ratio of as much as 40dB. The directional log periodic is manufactured with either an 80° or 90° horizontal 3dB beamwidth. Both beamwidth degree levels are available in two sizes, 24" × 8.5" and 48" × 8.5". The 48" version is also available with built-in upper lobe suppression and null fill. The gains of the antenna range from 9dB to 13dB.



Circle (411) on Fast Fact Card

Sturdy wideband portable offers 16 channels, field programmability

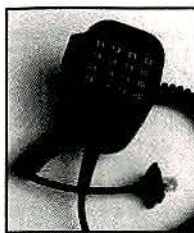
The HX381 portable radio from **Standard Communications** is designed for industrial, public safety and emergency response applications. Providing wideband capability in both UHF and VHF frequencies, the compact radio delivers 0.5W of audio output. The sturdy polycarbonate case withstands shock, vibration and extreme environmental conditions. The radio offers 16-channel operation, multiple signaling formats (including CTCSS, DCS, burst tone, two-tone and 5/6-tone) and features priority and user-selectable scan modes. Field-programmable and cloneable, the unit has a non-volatile memory for storing frequency data. The unit is supported with a three-year parts and labor warranty.



Circle (412) on Fast Fact Card

DTMF microphone allows user selections, radio features reprogramming

The SmartMic microphone (LAA 0290) from **BK Radio** combines the attributes of field programming and ruggedness for Bendix/King E-Series radios. The mi-



crophone has a 16-key DTMF pad that allows the operator to have user-selectable code guard, priority scan, priority scan list and group selection. For authorized personnel, the microphone's programming mode allows reprogramming of basic radio features such as frequencies, channels and tones.

Circle (413) on Fast Fact Card

GETTING MAXIMUM PERFORMANCE FROM EVERY INSTALLATION.

Bird's New Antenna Tester Eliminates The Guesswork!

Installing and troubleshooting cellular and mobile radio antennas can be a guessing game. Undetected problems with connectors, cabling, antenna placement — even glass characteristics — can drastically affect performance.

Bird's AT-800 rapidly tests any 806-960 MHz antenna. The self-contained RF source is preset for cellular bands. Or select your own frequency range. A 100-point scan of VSWR, Match Efficiency, or Return Loss is graphically displayed within a second. A simulated analog meter speeds single frequency tuning, and field strength mode verifies hand-helds. PASS-FAIL testing, audible indicators, and numerous other features make it easy to be sure. And the AT-800 is remarkably easy-to-use.

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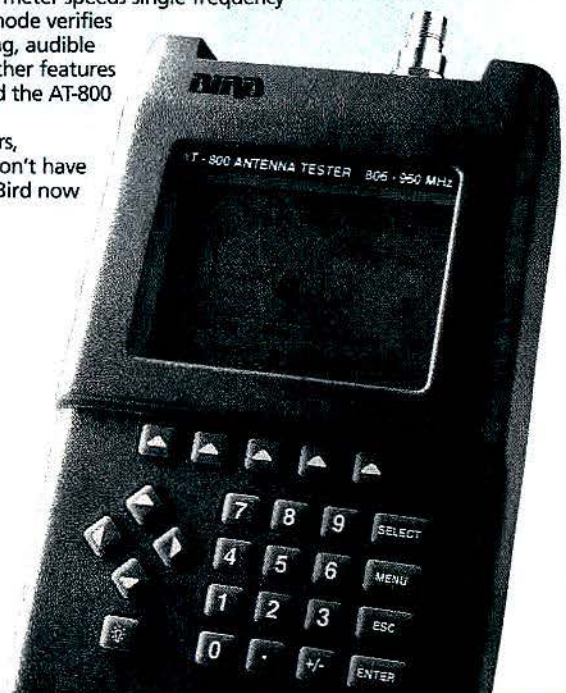
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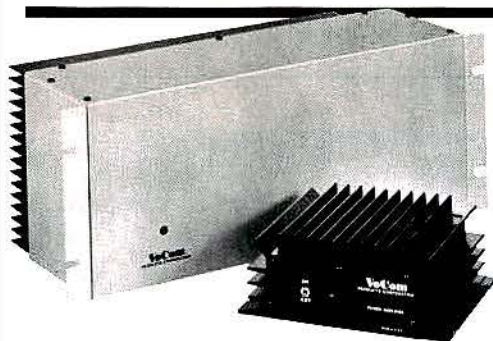
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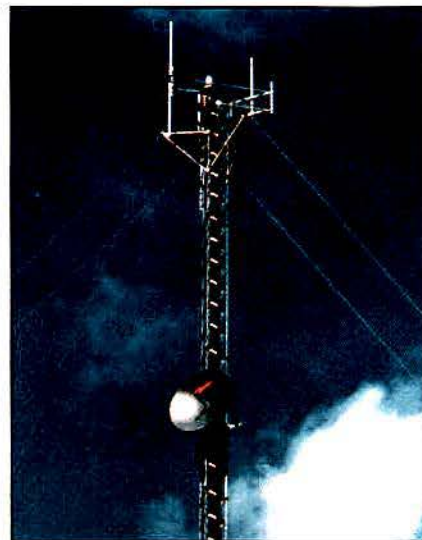
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Circle (74) on Fast Fact Card

New products

Additional face widths expand line of prefabricated, guyed towers



Four face widths have been added to Andrew's line of welded, solid round guyed towers. Widths of 24, 30, 42 and 48 inches are now available in addition to widths of 36, 46 and 56 inches. Tower heights range to 650 feet. Applications include land mobile radio, SMR, trunking, microwave, cellular and PCS. The towers have high-strength, round steel legs and welded-in-place cross members. Towers are delivered on-site in prefabricated sections requiring only nine bolts at the splice. Features include an articulated base, extra high-strength/bridge strand guy cables set in flexible anchor shafts, prepunched transmission line support channels and built-in ladders.

Circle (414) on Fast Fact Card

Tester indicates fault type present in BNC coaxial cable assemblies

The RFA-4017-1 coaxial cable assembly tester from RF Industries allows quick and easy testing of cables with BNC male terminations. (Adapters are available for other terminations.) Powered by a 9V battery, the tester indicates pass/fail on a front panel LED display that also indicates whether the failure is related to a short, an open conductor or an open shield. Already-installed cable can be tested with two testers.



Circle (415) on Fast Fact Card



New: R-505 Field Strength Meter



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Circle (76) on Fast Fact Card

Product Guide details rental products for testing and analyzing systems

A 235-page catalog details brand-name rental products in **GE Capital Test Equipment Management Services'** expanded inventory. The catalog provides quick-read technical charts for comparing similar equipment from different manufacturers. It contains equipment for testing, measur-

ing and analyzing the following types of systems: microwave and RF, communications, power transmission and distribution and industrial plant operations. The catalog highlights the company's repair, calibration and certification services.

Circle (370) on Fast Fact Card

Catalog descriptions cover new, used test equipment

A 32-page catalog from **Rag Electronics** lists new and used test equipment, including network analyzers, RF signal sources, pulse generators, oscilloscopes, telecom/datacom instruments, meters and counters. The company also buys used test equipment. Readers may fax the back cover to Rag, listing used test equipment they wish to sell.

Circle (371) on Fast Fact Card

Brochure provides overview of antenna line

A brochure from **Antennaco** provides an overview of the company's line of communications antennas. Included are medium-duty and heavy-duty yagis, omnidirectional and hemispherical antennas, dipoles, and antennas for PCS or PCN links. The brochure is intended to provide users and systems integrators with an overview of the company's products, as well as the company and its design philosophy.

Circle (373) on Fast Fact Card

Catalog and supplement feature test equipment, tools, supplies

A 144-page catalog and a 48-page supplement catalog from **Contact East** include new test instruments and tools for engineers, managers, technicians and hobbyists. Featured are products for testing, repairing and assembling electronic equipment. Product highlights include DMMs and accessories, soldering tools, custom tool kits, EPROM programmers, power supplies, ELF meters, reference books, breadboards, scope meters and portable and bench top storage scopes.

Circle (372) on Fast Fact Card

Catalog showcases wireless headsets

An eight-page color catalog from **Eartec** introduces the Max line of wireless headsets designed for industrial use. Each item listed includes a color photo, product description, a list of features and technical data.

Circle (374) on Fast Fact Card

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Circle (79) on Fast Fact Card

People

Scott Henderson exits Midland International, Kansas City, MO, as vice president of sales, to join Uniden America, Ft. Worth, TX, as vice president of the Commercial Communications Division.

Changes at Celwave, Marlboro, NJ:

Richard Chocolate, director of international sales and marketing, has been promoted to vice president of sales for U.S. operations.

Steve Aldinger, vice president of sales and marketing, has been designated vice president of marketing and new business development.

Leslie Black, vice president of sales for Anchor Graphics, Carrollton, TX, advances to president.

Changes at Transcript International, Lincoln, NE:

William J. Pogge leaves First Data, Omaha, NE, as senior vice president of sales and marketing to join Transcript as vice president of sales and marketing.

Beverly Keller, 1995 Lincoln, Wesleyan graduate in interpersonal communications and Spanish, joins Transcript as international sales coordinator for Latin America.

Doug Ehlers departs 3M, St. Paul, MN, as a process engineer to become a systems engineer at Transcript. He is a 1995 graduate of the University of Nebraska-Lincoln.

Doug Heerman, **Brad Riensche** and **Aaron Hall**, 1995 graduates of the University of Nebraska-Lincoln, join Transcript as development engineers.



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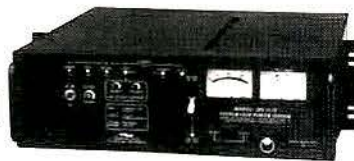
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Circle (81) on Fast Fact Card

L

etters from readers

Surge Protection:

The article "Systems Maintenance 101: Lightning and Verification." in the February 1995 issue covers several concerns very well.

May I offer something for your readers as an enhancement for "Zap" protection? I have used a "Brute Force" device for preliminary cleanup in several applications over the years. This is the Secondary Surge Protector from Square D, part number SP1175 (formerly J9200.) This is a device that physically mounts to a 1/2-inch knock-out in the service entrance box, and electrically connects to two, 120V-to-ground, "hot" conductors and one ground conductor, providing some protection on those hot conductors.

When more sophisticated filtering and arresting arrangements are used on branch circuits or individual equipment following this device, they are saved the trouble of eating the major part of the surge themselves. I believe this prolongs their lives and reduces their failure rate. (Sort of puts them on a "Surge Light" diet....)

Over the years, I have installed these units in a ceiling-hung stadium projection system (protecting the xenon lamp's power supply from lightning hits to the rooftop—the failure rate dropped substantially), mobile TV trucks and several business locations, and each of my homes. They are not a substitute for a really good transient suppression scheme for really delicate equipment, but I think they contribute to the overall quality and longevity of the protection system.

These items should be available through Square D distributors (although not all stock them). They list for about \$50, but will usually be about \$30 to commercial users. Because this unit only has two hot wires, you need to buy two units for a three-phase service entrance, like 120V/208V. There is also a higher-voltage unit for 480V, three-phase applications, the "SP3650."

I hope this information can be of some use to your readers.

Mark Sutton
Technician

KATU Television
Portland, OR

Fast Fact Card comment:

The toughest problem facing me on the job is people who don't use the *Release to Listen* button.

Justin Moon
Communications Director
EMS Post # 911
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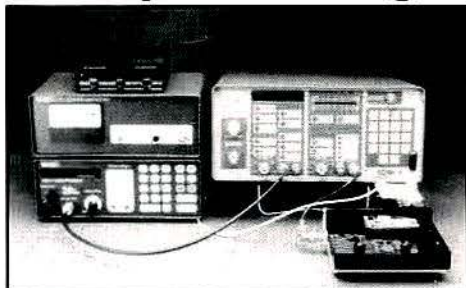


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1	Motorola Mitrek console 30w local control pl or dpl vhf	495.00
2	Motorola flexar control stations 15w local control pl or dpl vhf	300.00
1	Motorola flexar control stations 15w local control no pl vhf	200.00

Paging Transmitters

1	GE Mstr 2 300w vhf tone or de remote Tube PA	2500.00
1	GE Mstr 2 220w vhf de remote Solid State PA	2800.00
1	Motorola Micor 350w vhf tone or de remote	2750.00
2	Motorola Micor 350w 47mc tone or de remote pl or dpl	2500.00
2	Motorola Micor 75w vhf tone or de remote	1500.00
1	Motorola Micor 110w vhf tone or de remote	1500.00
1	GE Mstr 2 300w 43mc duty	1750.00
6	GE Mstr 2 100w vhf de or tone remote	1250.00
1	Motorola Micor 100w de or tone remote 47mc continuous duty pl or dpl	1750.00
1	Motorola Mitrek 100w console local control pl or dpl 47mc	1250.00
1	Motorola Mitrek 100w console local control pl or dpl vhf	1250.00
1	Quinton 30w 35mc with pure option looks new	1750.00

Repeaters

2	Motorola Micor 75w pl or dpl vhf	1750.00
3	Motorola Micor 12w pl or dpl vhf	1275.00
1	RCA TAC300 Tone PL vhf 20w	595.00
1	RCA TAC300 Tone PL vhf 60w	795.00

Remotes

5	Motorola T-1600 Remotes (DC or Tone)	275.00
1	Motorola T-1617 Remote 8 Freq DC (not tested)	400.00
5	Motorola T-1800 Telephone Style Remotes (tone)	125.00
5	Motorola T-1800 Telephone Style Remotes (DC)	125.00
5	Motorola T-1900 Telephone Style Remotes (tone)	125.00
5	Motorola T-1900 Telephone Style Remotes (DC)	125.00

Mobiles

20	Motorola mitreks 110w pl or dpl 39-50mc with accessories	425.00
1	Motorola mitrek 60w vhf pl or dpl with accessories	325.00
1	Motorola mitreks 50w vhf pl or dpl with accessories	195.00
1	Motorola mitrek 30w vhf pl or dpl with accessories	195.00
50	Motorola mitreks 60w pl or dpl 29-39mc with accessories	195.00
40	Motorola maxar 80 pl 50w 4l vhf with accessories	175.00
25	Motorola maxar 80 pl 30w 4l vhf with accessories	170.00
20	Motorola maxar 80 pl 30w 1l vhf with accessories	175.00
25	Motorola mossy pl 60w 36-42mc with accessories	175.00
10	Motorola maxar pl or dpl 40-50mc with accessories	175.00
50	Motorola M-70 pl 45w vhf with accessories	125.00
5	Motorola M-70 110w pl 40-50mc with accessories	250.00
10	Motorola M-70 25w pl vhf with accessories	125.00
3	Motorola Syntors vhf 30w with syn 90 accessories no pl	300.00
10	Motorola Syntors T83TXA3200 vhf pl 11VP capable no access not tested	300.00

Mobiles (continued)

8	Motorola SyntorXX T74VJB7D04AK 100w Wide Space W/Access	450.00
6	Motorola Syntors T45VJB5G00AA 800 Trunked no accessories not tested	250.00
6	Motorola Syntors T83SRA3200 vhf pl with accessories	425.00
1	Motorola Syntor T35VJ15G00AA 800 Trunked no accessories not tested	250.00
3	Motorola Syntor T63SRA3200 vhf pl with accessories	425.00
2	Motorola Syntor T111071AS RF Unit for Super Console Control Sta	175.00
20	Motorola Micors 110w pl vhf with accessories	250.00
40	Motorola Micors 110w pl 42-50mc with accessories	250.00
10	Motorola Micors 110w pl 36-42mc with accessories	250.00
10	GE Mstr 2 100w CG with accessories vhf	225.00
10	GE Mstr 2 45w no CG with accessories vhf	125.00
10	GE Exec 2 100w with access 31mc CG	225.00
5	GE Mstr 2 60w with access 31mc CG	375.00
20	GE Mstr 2 100w CG with accessories 42-50mc	225.00
10	GE Exec 2 100w no CG with accessories 42-50mc	225.00
10	GE Exec 2 100w no CG with accessories 36-42mc	225.00
6	GE Custom Mvp no CG no access not tested good for parts vhf pk/3	75.00

Mobile Phones

1	GE MTX-8712 Full Duplex 800mc phone for Trunking Sys	450.00
40	Motorola Pulsar 2 & Pulsar 100 vhf with access can't test here	275.00

Duplexers

1	Close space band pass and band reject vhf 600 ke spacing	600.00
2	Motorola 2 cavity band-pass and band-reject vhf T1485 3mc spacin	275.00
1	Motorola 4 cavity band-pass and band-reject vhf T1487	375.00
15	Misc cavities and filters vhf and uhf	75.00
1	DB Products 6 cavity band reject uhf rack mounted	325.00

Chargers

20	Motorola MT-500 1hr desk chargers Omni Size	65.00
3	Motorola Mx-300 1hr rack chargers	125.00

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2	GE Mstr 2 44" (fan cut-outs in rear door)	250.00
2	GE Mstr 2 72"	350.00
4	EF Johnson 43" chocolate brown	225.00
2	EF Johnson 60" chocolate brown	350.00
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8	Motorola Micor Repeater Power Supplies with Battery Backup	350.00
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4	Motorola Modem 100 good condition	75.00
2	Motorola Modax 100 good condition	100.00
2	Motorola Modax 500 good condition	150.00
2	Motorola Modax 1000 looks ok	400.00

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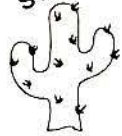
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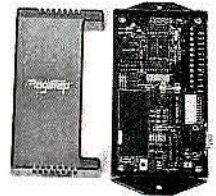
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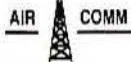
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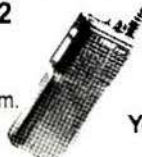
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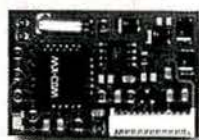
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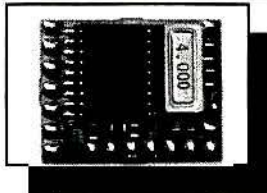
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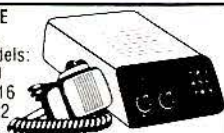
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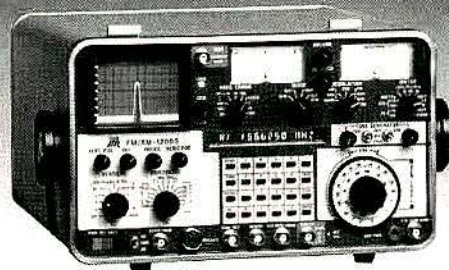
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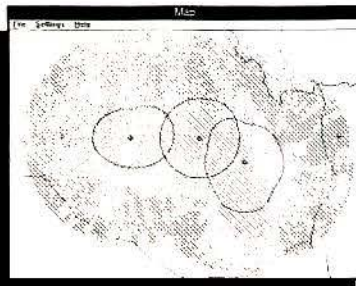
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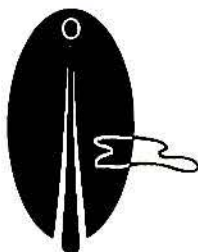
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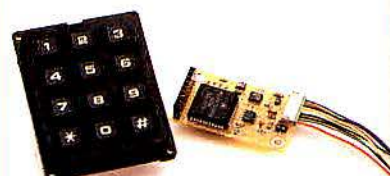
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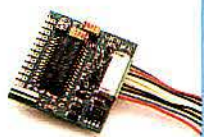
Two-tone Sequential Decoder. Programmable unit provides switched outputs from two-tone paging calls. 1.25" x 2.0" x .4"

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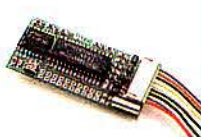
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